INTERNATIONAL REVIEW

OF THE

SCIENCE AND PRACTICE

OF

AGRICULTURE

PUBLISHED BY THE INTERNATIONAL INSTITUTE OF AGRICULTURE

New Series

Vol. IV. – No. 1 — January-March 1926

ROME

PRINTING OFFICE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

1926

In quoting articles, please mention:
International Review of the Science and Practice of Agriculture,
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PUBLISHED BY THE INTERNATIONAL INSTITUTE OF AGRICULTURE

New Series

Vol. IV. – No. 2. – April-June 1926

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OF THE
SCIENCE AND PRACTICE
OF
AGRICULTURE

PUBLISHED BY THE INTERNATIONAL INSTITUTE OF AGRICULTURE

New Series

Vol. IV. – No. 3. – July-September 1926

ROME

PRINTING OFFICE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

1926

In quoting articles, please mention:
International Review of the Science and Practice of Agriculture,
International Institute of Agriculture.

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INTERNATIONAL REVIEW
OF THE
SCIENCE AND PRACTICE
OF
AGRICULTURE

PUBLISHED BY THE INTERNATIONAL INSTITUTE OF AGRICULTURE

New Series

Vol. IV. — No. 4. — October-December 1926.

ROME
PRINTING OFFICE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE
—
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ORIGINAL ARTICLES

THE FERTILITY OF EGYPT.

I. The principal factors of the agricultural wealth of Egypt.

The *annual national revenue* of Egypt is estimated at approximately 300 million Egyptian pounds.

The total revenue of landed property, which at present has an area of scarcely two and a quarter million hectares under cultivation, amounts to 148 million Egyptian pounds, of which 108 million represent approximately the *value of the annual crops*. The wealth of Egypt is therefore considerable and agriculture is the principal source (1) (2) (3).

Of the natural and artificial factors of this wealth, will be mentioned only the more important of those which are directly connected with the production of the soil:— *the geographical position, climate, rural manual labour*, and lastly the *soil* and the *river* which waters it.

The geographical position influences *commerce* and the *flora*. Situated at the junction of two seas, on the banks of a great river, at the meeting point and on the maritime route of three continents, Egypt has always been a centre of international trade. However, until about a hundred years ago, transport held precedence over real exportation, but the introduction of the cultivation of cotton and sugar-cane has reversed this relation (4). Agricultural produce

constitutes almost the whole of the exports of which cotton alone represents 84 % (5). Owing to its geographical position this country has a great advantage as regards the transport of this rather bulky textile. The history of the commerce of Egypt shows that a strong, far-seeing Government has always been one of the essential conditions of her prosperity.

The influence that the geographical factors, assisted by climatic conditions, have exercised on the *flora*, both wild and cultivated, has been considerable. Owing to her numerous connections, Egypt has, in the course of years, tripled the number of plants which were formerly cultivated (6) (6'). This number now amounts to about 150. The very interesting story of these acquisitions is not only the history of Egyptian agriculture but also that of her external relations, the story of which has been related elsewhere (7). Experiments of acclimatization date from very ancient times. They have been carried out to such an extent that it is difficult now to add to the number (8).

The *climate* of Egypt has great advantages. It is generally fairly uniform and free from extremes. There is no excessive heat or very dry weather during the warm season, which favours the production of fine cottons and maize in the Delta and it is not too cold in winter, which allows " bersim " (*Trifolium alexandrinum*) to be grown throughout the country. Although uniform, the climate shows sufficient differences between the south and north to require from the farmer some discretion in the choice not only of the species, but also of the varieties grown, which accounts for the following geographical disposition of crops :— cotton, flax, sugar-cane, maize, millet, beans, barley, " bersim, " lucerne, fenugreek, lupins, chick-peas, vetch, tares, lentils, onions, sesamum, ground-nuts, henna, melons and water-melons, grow in all parts of the country. The fine cottons are however special to Lower Egypt. Upper and Middle Egypt are preeminently the regions for the sugar industry, and also of millet, onions, lentils, vetch, tares, lupins, chick-peas and beans. The poppy, safflower and indigo, now neglected, used to be especially important crops in these areas.

Maize, ground-nuts, sesamum and henna are grown more in Lower Egypt.

Rice, " dinébé " and " samar " are crops confined to the north of Lower Egypt and the Fayoum (7).

In the distribution of crops the varied nature of the soil also has an important, and sometimes a dominating influence (9).

Native labour is abundant and satisfactory and forms a powerful factor in the prosperity of agriculture and, consequently, of the wealth of Egypt. The "fellah", of whom both savants and travellers have spoken highly, adds to strength, activity and endurance, a traditional experience, and a profound love for the soil. This instinct, the extraordinary fecundity of the race and the fact that cultivable land is scarce, and bounded by the sea and the desert which hinder emigration and assure to agriculture, in spite of a very high infantile mortality, an inexhaustible supply of manual labour, safeguard Egypt from that social evil, the exodus of the rural population to the towns (4).

The soil and the Nile. — Throughout the centuries the fertility of the Nile valley has caused universal admiration. The arable land in Egypt is the gift of the river, and is very largely formed of mud brought down by the Blue Nile and the Atbara.

The Egyptian soil owes its fertility especially to:—

(1) *The very varied mineralogical composition.* The original rocks from which the soil is formed are principally volcanic, and eruptive, crystalline and sedimentary, and to these has been added very valuable transported material.

(2) *The extreme tenuity of its constituent elements.* Egyptian soils contain from 35 to 80 % or more of clay, of which sometimes more than 8 % is colloidal clay. Owing to this tenuity its elements offer a very large surface to the action of dissolving agents and impart to the soil particles a great absorptive power, which fortunately corrects the action of certain injurious salts (notably alkaline carbonates).

They thus acquire great importance in the cracking of the ground which, as will be shown, contributes to the maintainance of the great fertility of the soils of this country.

(3) the conditions of moisture and climate which, as has been shown, are very favourable.

(4) *The presence of certain salts* (especially calcium salts), which are important from the point of view of chemical, physical and biological factors.

Analyses and manuring experiments confirm the richness of Egyptian soil in fertilizing elements, *except in nitrogen* (10) (11) (12) (13).

Without the Nile, however, this land would only be an arid desert. The Nile is distinguished for its remarkably regularity of conditions and by the relative slowness of its flow. A rather sluggish river, it deposits, long before reaching Egypt, all coarser sediment, bringing there only the finest elements (14).

Fortunately, during the greater part of the year, the water contains in solution more calcium and magnesium than sodium and potassium, which prevents the land which it waters from becoming alkaline, compact, impermeable and more or less unproductive (10).

Another advantage which the Nile has for agriculture is the relatively high temperature of the water (8).

Lastly, the Nile not only waters the crops but constantly fertilizes with mud the valley which it has formed (10).

II. The principal conditions of the maintenance of the fertility of the Egyptian soil.

After having thus reviewed the principal factors of the agricultural wealth of Egypt, the essential conditions may be discussed which assure to the soil of that country the maintenance of its great fertility (10).

During many thousands of years Egypt has practised under the ancient system of basins, a method of cultivation similar to the "dry farming" of the present day.

The ground was not tilled, the surface was only slightly disturbed for some crops; it was not manured and although produce of the same kind was taken every two years, the soil yielded fairly regular crops.

This regularity which has frequently been commented upon, was, in our opinion, especially due to a favourable combination of circumstances which assisted production and *made the best use of a scientific rotation of crops.* The whole formed an efficient system, every detail of which was scientifically justified. The system was practised with plants adapted by several centuries of natural selection, to the conditions of the environment; the method of cultivation was both simple and economical; there was no fear of scarcity of water or manual labour, or of live stock or implements. Under the climate of this country frosts and bad weather are alike rare during the winter. No anxiety was feel as regards drainage

or the level of the water table. No special or costly arrangements were necessary for the regulation of irrigation water.

A stratum of naturally-rich alluvium was worked, which was annually drained, renewed, and in addition enriched by the fertilizing water of a river with remarkably regular conditions. The land, in the great majority of cases, was only cultivated in winter. In the rotation of crops, cereal or the industrial plants alternated with leguminous plants. After the winter crop, the land was left fallow, exposed to the heat and drought until the following high Nile. This long period of dry fallow is known as the "charaqi" period.

The leguminous-cereal rotation, used with great judgement, has contributed very much to the productivity of the soil and the constancy of its yield. The leguminous plants derive from the air the nitrogen necessary for the cereals and industrial plants, thus providing against the relative poverty of the soil in this indispensable element. This part has been played for nearly 14 centuries by the valuable "bersim". Imported in the VIth century from the Balkan peninsula, "bersim" is not only a valuable forage plant, but also a weed-destroyer and very useful as regards freeing land from salt, or in connection with the permanent drainage of land. There are few other plants which are so important in local agriculture.

The soil lies fallow after the winter crops and under the combined action of the heat and drought during a long period, undergoes considerable contraction which causes it to crack in every direction. This cracking, as has been proved long age, is one of the most effective causes of the maintenance of the fertility of the Egyptian soil under the old basin system (20) of cultivation.

The principal factors which contribute to the desiccation and cracking of Egyptian soil are :— the temperature of the soil (from 55° to 70°C. and over), evaporation (from 2.5 mm. in the north, to 13.5 mm. at Assouan), the level of the underground water-table and lastly the nature of the soil.

The linear contraction of a soil subject to desiccation is controlled on one hand by the degree of dispersion of the soil particles and on the other by the degree of aggregation of these particles. With more colloidal clay there will be less aggregation and the greater will be the contraction in volume during desiccation (10). It has been shown elsewhere that the quantity of colloidal clay in the

Nilotic deposits expressed as a percentage of dry soil, varies from 1.75 for sandy alluviums to 8.65 for clayey alluviums (11). Contraction varies between 30 and 45 % in volume according to the soil. There has been recorded, during the " charaqi " period in land, near Cairo, a subsidence of 8 cm. followed by an approximately equal rising during the growth of " bersim ". The cracks attain a depth of 0.25 m. to 1.5 m. and more. The width of the cracks at the surface often exceeds 10 cm. The total volume of the empty spaces is often more than 50 % in the south of the Delta. It is still higher in Middle and Upper Egypt (10) (15).

Owing to the combined action of heat and desiccation, the benefits of the " charaqi " period are many. There is first of all a very important result caused by the cracks in the permanent freeing of land in the Nile valley from salt. The epipolhydric function being more important than the bathydric function, especially in northern regions, and the cracked soils behaving from this point of view like permeable rocks on a large scale, where the cracks play the part of pores, it is evident how useful these cracks were for the permanent drainage of Egypt during the many centuries through which the basin system lasted (10) (15) (16) (17) (18) (19). But the " charaqi " period has other not less valuable advantages. It modifies in a very favourable manner the physical, chemical and biological properties of the soil (10) (20).

The cracks introduce air to considerable depths in the soil, where it is distributed in an infinite number of increasingly small ramifications, until the capillary spaces are reached. In this way the air is distributed throughout the whole mass. The aëration thus produced, in depth alone, would be difficult to attain with the best implements. On the other hand, the mellowing of the soil allows of a greater absorption of water and in a short time a comparatively uniform distribution of moisture at all levels, results.

The heat and desiccation of the " charaqi " season, by their action on colloidal matter, contribute largely to the maturing of recent deposits of Nile clay of a certain thickness, which are uncultivable the first year.

Thus the " charaqi " period improves the physical properties of the soil and notably its permeability, porosity and capacity for air and moisture (10).

As regards chemical properties, the phenomena of oxidation, which maintain the soil in a normal condition, should first be noted.

Next, the transformation into bicarbonates of alkaline carbonates which are frequently formed in the sub-soil of low, clayey, badly aërated soils.

Moreover, the cracks enable atmospheric agents to act with ease and intensity on the mineral constituents of the soil. Lastly, under the action of heat and desiccation the colloids, which coat the minerals in the soil and cement the soil particles, become dehydrated, contract, crack or crumble to dust, and the soil after each "charaqi" period, is to a certain extent renewed and regenerated (10).

From a biological point of view, the "charaqi" period exercises an effect similar to that of a partial sterilization (21) (22) and causes an "awakening of the soil" after the following high Nile (10).

During the fallow period, the nitrogenous organic matter, elaborated by the leguminous plants of the rotation, remains more or less intact in the soil. But as soon as the flood water abates, owing to the partial sterilization which the soil has undergone during the "charaqi" period, nitrification of this organic matter takes place actively, for the greater benefit of the cereals which succeed the leguminous plants. The "charaqi" period has the effect, in short, of putting the soil in a condition to produce, at a given moment and in sufficient quantity, directly assimilable nitrogen, an element the great importance of which in Egyptian agriculture has been shown (10).

The heat and desiccation destroy also the germs of most of the pests, animal and vegetable, of the cultivated plants (10).

After the long "charaqi" period, the basins became refilled during the flood of "red water", which remained there for 50 to 70 days. They emptied themselves into the bed of the river or into lakes on the borders of the Mediterranean before the sowing of the winter crops, that is to say towards the end of October or the beginning of November, according to the district. Each hectare received about 13 500 cubic metres of water, of which it absorbed approximately 10 000 and which enriched the land by depositing more than 15 tons of mud per hectare (10). During the inundation, bacteriological activity is small, there is complete arrest of nitrification and accumulation of ammonia (21). But as soon as the water falls, the conditions again become aërobic, nitrification takes place vigorously, ammonia disappears and the effects of the

partial sterilization immediately make themselves felt to the great benefit of the newly sown crops (10).

In the course of the early part of the XIXth Century irrigation by basins was suppressed, in the Delta and in the Fayoum, to give place to perennial irrigation. In Middle Egypt, the convertion of part of the basins was not carried out until the beginning of the XXth Century, consequent on the construction of the Assouan reservoir. That substitution has modified considerably the conditions of production.

A progressive decrease is observed in the yields of certain crops during the last twenty years and the growing anxiety which it causes contrasts singularly with the views generally held in former times.

However it has been shown elsewhere that:—

(1) this decease is due mainly to unscientific management of the soil and to ill-advised practices which have arisen from the excessive expansion of cotton-growing;

(2) the causes which determine it do not affect the fercility itself of the soil in a permanent manner;

(3) the return to the triennial rotation of scarcely twenty-five years ago, coupled with the already common use of suitable manures, as well as the still uncommon use of selected seed, would suffice to arrest this regression (10).

For this reason we believe that Egypt can still look forward with all confidence to a future which, under the aegis of an enlightened Sovereign, holds out the surest promises of prosperity.

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THE CULTIVATION OF SAFFRON AND ITS IMPORTANCE IN SPAIN.

The cultivation of saffron (*Crocus sativus*) is extremely ancient in Spain, although only in the VIIIth century the Arabs improved and extended it to the areas where it is now found.

Spain and South America are the only countries where the Arabic *alzafrán* remains in the word *azafrán*, while in other parts of the world is found, more or less changed, the primitive Persian *safrán*. Saffron has lost its original importance as a colouring plant, the dyes that could be produced with it not being strong enough and having been advantageously substituted by mineral dye-stuffs. But its wide use in medicine, in the making of pastry and liquors, in the manufacture of soup paste (pasta italiana) and, above all, as seasoning, are quite sufficient to justify the importance of its cultivation and the value of its collection in Spain.

In the whole peninsula and, especially in such areas as La Mancha, Levante and Andalusia, no food is cooked without being seasoned with saffron. The long Spanish domination in Central and South America has left in those countries the same taste that is, moreover, peculiar to Mediterranean nations. The area of land under saffron cultivation in Spain is now about 12 406 hectares, distributed as follows:

Provinces	Hectares
Albacete	4 350
Teruel	3 750
Cuenca	1 920
Toledo	1 160
Zaragoza	590
Valencia	400
Murcia	124
Ciudad-Real	98
Soria	14
	12 406

As the average saffron production is about 12 kg. of stigmas per ha., there is an annual average production of 148 872 kg. that, at the average price of 224.86 *pesetas* per kg. (data, 1919-23), gives the total yield a value of 33 475 357.92 *pesetas*.

In addition, after the fourth year saffron must be uprooted, when there is a yield of tubers (commonly termed onions) of about 12 500 kg. per ha. (Plate I, figs. 1, 2, 3). This allows about 387 687.50 kg. for new plantations and for feeding livestock and, at the average price of 10 *pesetas* per 100 kg., has a value of 3 876 875 *pesetas*. The saffron leaves, termed *Espartillo*, when dried, are stored for use as a winter feed for dairy cattle. The average production being about 800 kg. per ha. there is an annual crop of 9 924 800 kg. which, at a price of 4 *pesetas* per 100 kg. reaches a total of 396 992 *pesetas*.

The value of the annual output of saffron in Spain is as follows:

Stigmas	33 475 357	pes.
Tubers.	3 876 875	»
Leaves.	396 992	»
Total	37 649 224	pes.

From the above, the importance can be seen of saffron in national economy. The plant occupies $^{1}/_{60}$ of the total area occupied by industrial plants, and as regards the value of the crop, takes the fourth place being surpassed only by sugarbeet, red pepper and sugarcane.

From the following tables (I. and II.) may be seen the great importance of the saffron trade in Spain, owing to its always having been celebrated for its strong colour and penetrating aroma.

The amount exported is about half the total production, hence, the consumption per head in Spain is about 4 gm. per annum.

The chief markets are in: La Mancha, Albacete; in Aragón, Calamocha and Montalbán, and the chief export towns, Barcellona and Valencia.

Saffron is graded by the length of the stigmas, the aroma, the colour and the degree of purity, into the following four classes: *Selected*, *superior*, *superior ordinary* and *ordinary*.

The former are sent to Marseilles, Pitiviers, London, Liverpool,

TABLE I. — *Kg. of saffron exported from 1919 to 1923.*

Countries	1919	1920	1921	1922	1923
Algeria	1 715	721	840		
Argentina	17 609	11 751	15 523		
Cuba	10 533	22 514	13 135	(1)	
United States	2 071	3 036	1 014		
France	46 792	29 274	26 823		
England	7 258	3 097	2 410		
Other countries	42 749	18 077	8 320	45 989	50 922
Total	128 727	88 470	68 075	45 989	50 922

(1) From this year all data are combined.

TABLE II. — *Value of exported saffron.*

Years	Kg. exported	Price per Kg.	Total value
1919	128 727	132.33 pts.	17 034 443 pts.
1920.	88 470	170.27 »	15 063 786 »
1921.	68 075	200 — »	13 615 000 »
1922.	45 989	271.73 »	12 496 590 »
1923.	50 922	350.86 »	17 822 700 »
Average	76 436	224.86 pts.	15 206 504 pts.

Amsterdam, Hamburg and Trieste. The latter to Cuba, South America, North Africa and India, where Spanish saffron is highly valued and is used for religious ceremonies.

SPECIAL CONDITIONS OF SAFFRON CULTIVATION.

Saffron cultivation requires a great deal of hand labour, especially in gathering the flowers, which must be done on many successive occasions, and in the separation and drying of the stigmas. Therefore, the area of saffron cultivated by each labourer is not large, and is what he can take care of with his family, and varies from 5 to 50 ares.

The land under saffron is always to be found near well populated centres in order to takes advantage of the labour and to save time. This proximity is also essential, excrement being the only manure used.

The persons who cultivate saffron are not generally farmers but working men of all kinds (masons, blacksmiths, tanners) who, on Sundays and feast days, and before and after their daily work, alone or with their wife and children, take care of the saffron crops. Under such conditions the saffron production is for them an extra source of income; being easily preserved and fetching high prices it is very valuable during times of shortage. It may therefore be said that saffron provides comforts for the working class and lessens the effects of labour crises.

The cultivators of saffron are not generally the owners of the soil, but hire the land for four years. The owner usually grants a lease to a farmer who, in his turn, divides the soil into plots of 5 to 20 ares being guarantee for the rent of those to whom he has sublet the land. In the province of Albacete this rent varies from 120 to 300 pesetas per ha., but reaches 450 pesetas near Valencia, a much higher price than is paid for unirrigated land. The leases are usually terminated on St. Andrew's Day, 30th of November.

The area cultivated by each worker not being large, causes changes in the total cultivated area and in the whole production to be very small, hence, both area and yield may be considered as constant quantities.

In Spain, saffron is usually grown on the same soil for four years before uprooting, as, after that, the tubers multiply, almost reach the surface, hinder cultivation, cause the growth of weeds and so lessen the output. In France, saffron is uprooted after the third year, because owing to a richer manure the tubers multiply in less time. To obtain a second satisfactory crop of saffron, 20 years must be allowed to elapse on unirrigated and 10 on irrigated soils.

Agricultural Conditions.

The climate of the areas in which saffron is cultivated in Spain may be called temperate and peculiar to upland. Although the crop is found in Valencia and Murcia, it is only on the limits of Requena and Jumilla that, being near Albacete, have the same climate instead of the warmer one found in the central parts of those provinces. In Table III is shown the average yearly temperatures and the amount and frequency of rainfall in those provinces (sea page 14).

The average temperature for the whole saffron area is from 10°-15°C., with a minimum of 12°C. and a maximum of 38°-40°C.

TABLE III. — *Temperature and rainfall data.*

Provinces	Average annual temperature	Rainfall in mm.	Number of rainy days
Albacete	13.6° C.	381	61
Ciudad-Real	15.0° »	456	97
Cuenca	11.6° »	438	98
Soria	10.2° »	567	96
Teruel	11.8° »	387	65
Toledo	14.0° »	387	64
Zaragoza	14.7° »	295	66

As saffron remains inactive and deeply buried in the soil during the summer it cannot be injured by excessive heat, and during the winter the labourer protects it with a covering of well softened and fine earth so that the plant is not affected by the great differences of temperature. If the autumn is warm the flowers are early, but during this period frosts are very dangerous.

The saffron area may be termed dry, as in few places the annual rainfall exceeds 400 mm. To obtain a good yield two heavy rainfalls are sufficient, one in spring for producing the new tubers required to form the crop during the following autumn and another at the end of summer or beginning of autumn to help the blossoms and flowers.

In such conditions of temperature and rainfall is obtained the celebrated *azafrán manchego y aragonés* so appreciated in foreign countries for its bright colour and penetrating aroma and that can be compared only to that grown in France in the Gatinais.

Saffron grown on irrigated land gives a more regular and abundant crop, but has not such a good colour and aroma and is therefore sold at a lower price.

Saffron does not require a rich soil, but it must be light so that the tubers can develop. A good quantity of lime is also beneficial; the best saffron is grown in the Albacete province where the soil contains more than 40 % of lime. Cold and damp clay soil is not suitable for saffron. The manure almost exclusively used is excrement. After a short decomposition it is applied in amounts of 10 to 15 000 kg. per ha., before the last cultivation in the preparation of the plantation, and nothing more is added.

If the manure is not very abundant, it is put in the furrow when planting out. In Requena (Valencia) the excrement is mixed

with $^1/_5$ of its volume of ashes. House sweepings and residues are also used after having been dried and mixed with earth.

The Estación de Agricultura General de Albacete has carried out manurial experiments and the best result has been given by the following application per ha.

Rotted manure	20 000 kg.
Superphosphate $^{16}/_{18}$	200 »
Potassium chloride (50 %)	150 »

During the following years 50 kg. of ammonium sulphate is spread in the furrows.

The yield of saffron is greater in France owing to the heavier rainfall and the more abundant manure, which causes more vigorous germination and consequently a greater quantity of flowers.

Method of cultivation.

Plantations being small all labour is done by hand, using as implements the spade for deep work and the hoe for breaking up the surface. For preparing the soil it is necessary to dig over the land twice; once in March to a depth of 25 to 35 cm., all stones, roots and rubbish being removed. The second takes place at the end of April or beginning of May, has a depth of 10 to 15 cm. and prepares the soil for the planting out. Manuring is carried out at the same time.

Planting out is done from the middle of May to the beginning of June. Middle sized tubers, sound and without the external covering, are put in double rows at a distance of 6 cm. and then again in another row at a distance of 3 cm.

These rows are placed at the bottom of small trenches, having a depth of 10 to 12 cm. and a breadth of 45 cm. The soil taken from one trench is used to cover the tubers of the preceding trench. If not given previously, manure can be applied during this operation.

No other cultivation is done in the first year until September, when the soil between the rows is lightly turned over with the spade to a depth of 6 or 7 cm.

In October, before the blossoming of the flowers, the surface of the soil is broken with the hoe and the operation is repeated

until the ground is well softened and does not hinder the growth of the plants.

After the harvest, at the middle or the end of November, the soil among the rows is once more dug to a depth of 12 to 15 cm. and, if not previously given, manure can then be mixed with the soil. At the end of April or beginning of May the saffron leaves are cut with a sickle and dried in the sun as winter food for livestock. After this the soil among the rows has to be once more dug to the usual depth.

On the 24th of June the ground is dug perpendicularly to the rows, thus turning in the residues left when cutting the leaves. This is considered a very important operation and its utility is celebrated by popular sayings. From this time on, until the ground is prepared for the gathering, the spade is used each month.

During the third and fourth year the same cultivations are repeated. After getting the fourth crop of saffron, in the month of May when the new tubers are already formed, the plant is dug up.

The external covering is taken from the tubers, the old and diseased tubers are thrown away and what is left is used for new plantations or food for livestock.

Gathering and preparation of saffron.

The gathering of the saffron flowers, known as "Cojida de la Rosa", takes place from the end of October to the middle of November, according to place and state of cultivation, but generally reaches its maximum on All-Saints Day (the first of November).

The gathering (Plate II, fig. 4) is done by women and children who go to the plantations before daylight, working from the first dawn untill about ten ; the work must be done quickly or the flowers would be withered, hence, a sufficient number of workers must be employed for this purpose. In cloudy weather the work may last longer ; after a white-frost time must be allowed for the flowers to dry before beginning.

The workwomen stand in a row on one side of the plot, near three rows, and walk in the direction of these rows, gathering the flowers of the central, right and left rows and putting them in a basket at their feet. They get thus to the other side of the plot where they walk in the opposite direction and so on. This must be repeated during 10 or 12 days, as long as the flowering lasts.

PLATE I.

FIG. 1. — Saffron tubers with the sheath leaves that give them the appearance of bulbs.

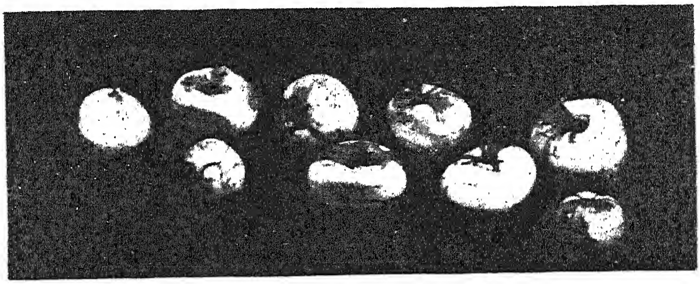

FIG. 2. — Tubers without their sheath leaves and showing the buds.

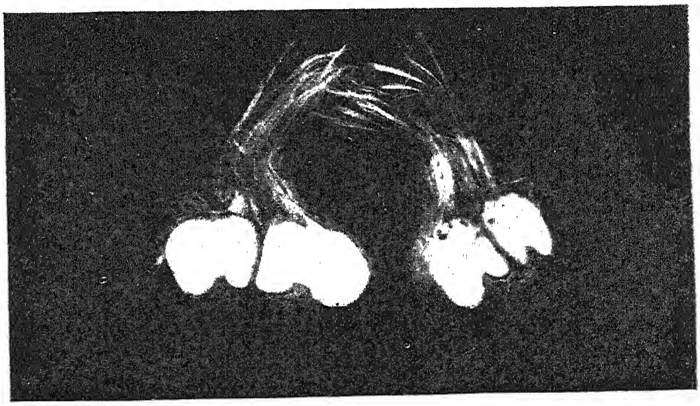

FIG. 3. — Section through a tuber.

PLATE II.

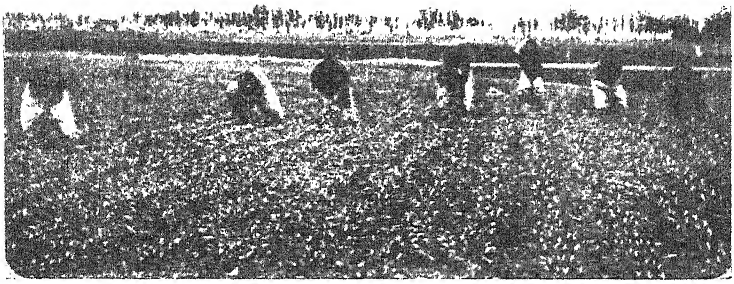

FIG. 4. — Gathering saffron flowers.

FIG. 5 & 6. — Typical scenes during the treatments of the flowers.

The gathering is paid as piece-work, the flowers being weighed, at the rate of 15-20 centimes per *libra* (460 gm.). The flowers collected daily must be cleaned, the stigmas being removed, as it is for these that saffron is cultivated, but this operation must not be delayed till next day, as it becomes much more difficult if the flowers are no longer fresh.

The flowers are then brought indoors and put on tables round which the working women sit, each of them with a small earthen pot in which are placed the stigmas (Plate II, figs. 5 and. 6) The work proceeds in the following manner: with the left hand they take a flower, cutting with the thumb nail the pistil under the corolla and pulling off with the right hand the stigmas. This operation also is paid as piece-work, 20 centimes per *onza* (1 *onza* = 28.75 gm.) of cleaned saffron; 80 kg. of flowers are required to obtain 1 kg. of green, or fresh saffron.

Green saffron must be dried, after which it can be preserved, developing at the same time, the colour and aroma that are its chief qualities. The flowers are desiccated by placing on silk sieves on worm ashes or in small earthen ovens made for that purpose. When green saffron is put on a sieve in small bunches the dampness causes it to adhere to the silk, but when dried the saffron slips over the silk. Therefore, the operation of putting the sieve near the fire must be repeated until the saffron slides over the silk. From 5 kg. of green saffron 1 kg. of dried saffron is generally obtained. After drying, the saffron is allowed to cool in a dry place, and is then packed in woollen material.

For export the saffron is packed in boxes, barrels or sacks.

Causes of damage to saffron.

Mice are very dangerous to saffron plantations, as they cause great damage and so they are controlled by all possible means. Sulphur, tobacco and hot pepper are generally burnt in order to drive them away. The most injurions saffron disease is the "Podredumbre" or "Hongo del Azáfran" (*Rhizoctonia violacea* Tul.). When the disease is severe nothing can be done but to dig up the plants, no way being known by which it can be controlled.

At the "Estación de Agricultura General de Albacete" attempts are being made to obtain tubers by means of seeds and artificial

fertilization, from sound tubers collected on plantations attacked by the disease, whith the object of obtaining saffron immune to the disease.

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THE IMPORTANCE OF LARGE AND SMALL FARMS IN INTERNATIONAL COMMERCIAL RELATIONS. *

The question here dealt with is extremely difficult from a theoretical point of view and very delicate from a political and social standpoint, but the correct solution of the problem may contribute largely to the health of international economic life, which has not yet been able to regain the equilibrium lost in consequence of the world war and the cataclysms which resulted from it.

As a consequence of the movement towards the towns and the increase of industrialism in most of the countries of Western Europe, they were obliged, even before the war, to import raw material and agricultural produce to support their population on the one hand, and on the other, to export their industrial products to provide work and in this way to balance their transactions.

This mutual exchange between agricultural and industrial countries, supplemented by the movement of capital and by emigration, has contributed largely to the remarkable economic development of the New and Old Worlds. As a consequence, the question as to what was the reason of the intensity of this exchange is suggested. It may be stated that, together with the commercial expansion of industrial countries, the intensity of international relations depends on the facilities for exportation of agricultural countries, which results from their rural production and internal consumption, as well as from their purchasing power of products of foreign origin.

But these factors depend also in their turn on the agricultural constitution of the country and on the level of general education and especially on agriculture.

If a study be made of the situation of world economy previous to the war, from the point of view of international relations, it is

* Report presented to the Section of Rural Economy of the Twelfth International Agricultural Congress, Warsaw, June 1925. (Full Text).

seen that in the countries concerned there are four chief types of economic-rural organization.

I. The Agricultural Organization of Western Europe. — The characteristic feature of this is the greal quantitative preponderance (both in number and area) of the smalt and medium size country estates and the high development of the pecuniary factors in the small farms.

Even the small rural properties, as has been shown by the interesting work carried out for a number of years by the Swiss Secretariat of peasants, under the direction of Prof. LAUR, are primarily business enterprises having for object the making of a profit on the sale of agricultural products.

The area of the farms has no influence on their character of enterprise; it depends rather on the nature of the produce; large estates are occupied with the production of wheat, while small properties deal with animal produce and horticulture. We have therefore to deal with a certain specialization of small and large rural properties, which is necessary in case of economic isolation of a given country, in order to provide for its internal requirements. The careful investigations of Prof. BRDLIK have proved that this specialization has, in addition, a deeper economic significance.

However, all these types of property produce for a market where they mutually supply each other with various requirements, in consequence of which the market becomes very absorbent and assists the development of industry. This specialization also favours, in normal times, the development of international commercial relations, (examples :— the products of stockbreeding in Denmark and Switzerland, sugar in Germany, Poland and Czecho-Slovakia, fruit and wines in France and Italy). The large and small rural properties share equally in this exportation; the latter have therefore also their part in international exchange. The stimulus encouraging production lies primarily in the desire for profit from rural economy, treated as an enterprise.

II. The Agricultural System of Eastern Europe. — Before the war, up to a certain point it was a survival of the feudal times, when only the large rural estate entered into the business of production, a type of partial capitalist enterprise; the peasant farms have on the contrary a signification of consumer and supplier of manual labour and teams required by the large estates. In places where the production of the farms was

not developed, and where the peasants paid rent, their property had the character of natural rural economy, producing not for sale but to satisfy their own requirements and to enable them to pay the rent which was frequently levied on produce.

The freeing of the peasants, which has radically changed their relations from a social and legal point of view, has not caused essential changes in economic relations, although it contained the possibility of equally radical changes.

The large farm remained for a long time the only business producer with the character of a capitalist farm, while the small peasant estate, newly formed, followed a natural development and produced only in order to satisfy the immediate requirements and to pay the high taxes and the purchase money of the land obtained. This latter, moreover, has been obtained by the freed peasants in the Russian districts in too small an amount, especially in view of the very low level of agriculture and the rapid increase of the population, the surplus of which has not been able to find employment in towns in consequence of the very slight development of industry. They were therefore forced to supplement, by renting, land of the large estates, and in this way were able to get from it a high revenue which it was increasingly difficult to obtain by means of their own administration, owing to the economic policy of the Russian Government, by which the development of agriculture was neglected.

The Russian peasants were forced to limit their consumption to a minimum in order to satisfy charges arising from too high a purchase price, heavy taxes and the large amounts paid for the rented land. It is for this reason that we have such facts as the exportation of wheat from Russia in years of famine, or the continual sale of wheat by the peasants in autumn at cost price in order to pay their rents and taxes, only to buy it back more dearly in spring by means of some chance profits.

Here therefore, even the small farms equally with the large, share in exportation ; the participation of the former was, however, to a certain extent qualified by fiscal and economic constraint on the part of the State and of the large estates.. The stimulus to production has not been therefore, as in the West, the desire for profit from the rural estate, treated as an enterprise, but the necessity of satisfying the most elementary needs and of making provision for burdens imposed by the social and political system. It

should however be mentioned that the agricultural reform undertaken by the Russian Government after the first revolution, and, as a consequence, the greater care taken of the same property, have produced rapid results in raising the well-being of the country. This leads us to think that, in this part of Europe, the small estate could develop in the same direction as that followed in the West.

III. The Agricultural System of the New World (United States, Canada, Argentina). — This farming system, was already before the war based on the principles of capitalist production ; it was therefore very closely connected with the international markets and it was to the requirements of these markets that production was almost entirely adapted.

IV. The various Colonial Systems. — These systems are based on the production of plantations worked by capitalist planters, natives or farmers, with the object of providing the market with certain products, so that they take an active part in international commercial relations.

It is evident that this classification under four types is quite artificial. In reality it is much more complex.

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It follows from what has been stated above that the small and large farms of the West of Europe, the farms of America, the various types of farms in colonial countries, and lastly the great estates of the East of Europe, before the war, took an active part in international trade, as agricultural enterprises exporting for profit. On the other hand, the small estates in the East of Europe did not, properly speaking, produce for sale ; if they sometimes supplied agricultural produce, it was almost exclusively under the fiscal pressure of the State, or when they were forced to do so by local conditions of possession, in cases where the owners found themselves obliged to pay large amounts for rent.

Some of the colonial farms were in touch with the markets simply from force of circumstances. Also the 2nd category of farms could not be considered as agricultural enterprises, as their object was not to produce with a view to profit, but simply to supply their own immediate needs. Contrary to the first category which has been referred to, which had developed in a considerable measure

the pecuniary factors in these farms, the second category has only attached slight importance to such factors.

Both the first and second of these categories evidently form an essential part of the particular systems of the farms of the States or of national agricultural economics. The latter were connected with each other owing to the complicated relations of commerce, finance and politics and formed a certain co-ordinated unit which was the system of world economy, before the war, in approximately a state of equilibrium, although even at that time certain symptoms that this equilibrium was not stable but could be upset, were evident. And, as a matter of fact, that equilibrium was lost by the war; its disturbance has brought about an economic crisis, perhaps in different degrees, but at any rate felt generally in both hemispheres for a series of years. Moreover, the regaining of this equilibrium is now the object of efforts undertaken by the most eminent statesmen, politicians and economists.

The economic consequences of the world war might been reduced, within the limits of the problem with which we are dealing, to three principal heads :—

(1) The almost total elimination of Russia from international commercial relations, both as an exporting country for agricultural produce and raw material and as an importing country for manufactured goods.

(2) The modifications in the international financial relations, in consequence of which America has become the creditor of Europe, after having formerly been its debtor, while at the same time she has acquired the necessary capital for the development of her industrial development.

(3) The development of measures having as their object emancipation, in colonial countries aiming at both political and economic independence.

What connection is there between the above and the problem with which we are dealing?

The connection can be shown by a general analysis. Let us first of all consider the relations in Russia.

Before the war Russia was the most important exporter of the five principal kinds of wheat on the world market. Of the total quantity of wheat supplied to this market, Russia's share, amounting to 600 million quintals, representing 35.10 %, while

the shares of other countries scarcely reached the following figures :—

Argentina	16.7 %
Rumania and Bulgaria	3.7 %
Canada	3.2 %
Australia	2.7 %

It is evident that the disappearance of such an exporter as Russia must upset the equilibrium of this market. Here the question arises as to what has caused such a sudden restriction of Russian exports. Evidently it has resulted from decrease of production caused by the world war, the downfall and its consequences, the almost total liquidation of the large estates, which before the war sent their produce to the markets, and the disappearance of large scale agricultural production.

However, according to the estimates of Messrs. ORGANOWSKI and GRONAN, Russian economists, the large estates supplied the markets with barely 25-32 % of the total agricultural produce sent there by Russian agriculture.

The ruin of Russian exportation cannot therefore be explained solely by the liquidation of the large estates, although that liquidation must have had a strong influence. The problem is much more complicated. It would seem that the key to this riddle and the explanation are to be found elsewhere. The production for sale of small estates had as its real motive a pressure exerted in some way, as has already been shown. When that pressure ceased to be felt, there was no longer any other factor capable of forcing the Russian peasant to produce for sale; his mentality contained too little initiative for enterprises and consequently too little desire for gain, the principal motive of production to the farmer of Western Europe.

Moreover the objective economic conditions were not favourable to production for sale. Ruined industry, depreciated currency, could not offer any concrete value to the farmer in exchange for produce. As for what he most desired, land, it was given to him gratuitously.

Consequently, the farmer consumed more; he adapted production solely to the needs of that consumption, sending to market only such produce as had been taken from him by force or such as

could assure him the possibility of providing for the few requirements which he was not in a position to satisfy on his own farm. The weak relations existing between the small agricultural units and the markets, and consequently their negative value in international commercial relations, which have already been mentioned, are here fully shown.

To the attempts made by the Soviet authorities, to force the small farmer to give up his produce to the towns, the latter replied by reducing production to a minimum, which ended in famine in Russia and forced the authorities to capitulate and to attempt a new political economy, allowing the free use of agricultural produce and contenting themselves with the collection of taxes in produce indispensable for the maintenance of the army, the administration and in part for the requirements of the towns.

The inability of the small Russian farmer to adapt himself to the exigencies of free production for sale, based on motives of a commercial nature, was further aggravated by the defective political economy of the Soviets, who arranged a great disproportion in price between manufactured goods and agricultural produce, to the detriment of the latter. This policy arrested the development of small farms, tending to develop in them a preponderance of the pecuniary element and to prevent them in this way from participating in an active manner in international exchange. What has been said of Russia is also true to a considerable degree of the other countries of Eastern Europe, where large estates were broken up and where small estates had not yet been reorganised for direct production for sale (example :— Roumania).

On the other hand, in countries where the small farms had been in closer contact with the markets before the reform, agricultural reconstruction has not caused such injurious consequences (Baltic States).

The sources of raw materials and agricultural produce, as well as the selling markets of manufactured goods, being in this way lost to international economic life, it became indispensable to replace them in some way. The United States lent assistance as regards the first point. They reduced their own consumption and enormously increased agricultural production, and succeeded in filling the gap left by Russia. Thanks to American agriculture, Europe has not succumbed to famine.

However, the war fundamentally modified the financial basis

on which, before the war, Europe had been the creditor of the United States.

The latter provided for the engagements arising from their debts by means of supplies of raw materials and agricultural produce. In this way, equilibrium of the balance has been established: The world war transformed the debtor into creditor. Europe could not now import agricultural produce from the United States by reason of the income from securities possessed or of the interest on credits which had been granted. Europe is now the debtor of the United States, and is forced to buy their produce and raw materials for cash or on credit, as she is not in a position to counterbalance their value by the export of manufactured articles. American industry is secured by customs duties against European competition. The balance of payment is consequently always to the detriment of Europe.

On the other hand, agricultural produce and raw materials from the United States are now too costly for impoverished Europe. Consequently the eminent American economist TAYLOR, estimates this question at its true value in affirming that in future the problem will not consist in the quantity of food stuffs which the United States can supply to Europe, but in the economic possibility of delivering these products to her. The provisioning of Europe by the United States is not a privilege for Europe, but a business for the United States. It is not only a philanthropic work of assistance, but primarily trading based on sound principles. TAYLOR, however, regards with pessimism the out-look of this trade in the future, affirming that Europe can eat more than she is in a condition to pay for and that nobody grants long term consumption credits. Moreover, there is room for a little scepticism, for other reasons, respecting the future of European-American trade in agricultural produce. The rapid development of the United States, the growth of their cities and the increase of industrialism, will probably, in a short time, cause the United States to be transformed from an exporting country into an importing country. In that case Canada and the Argentine Republic will export to the States their products in the first place, at the same time serving as their sale market. For the present, however, Europe suffers most from the elimination of Russia from the market and from the loss of its exports. This problem forms a capital question of to-day.

It follows from the above, and from the attempts at emanci-

pation by colonial countries or by those which, being independent, are in a preponderant sphere of economic influence of the States of Europe, that world economy, so far as it will reestablish the equilibrium upset by the war, will be based on principles other than those of the pre-war period.

It seems as though the period of economic imperialism is fading away. The future belongs rather to certain self-sufficient economic organisations, possibly to international or regional organisations. International commerce, however, will not, disappear. It will only be limited to industrial or commercial articles for production of which special economic organisations would be most suitable, either for climatic reasons, or for intellectual or demographical reasons.

What then is the importance which more or less extensive farms may have in this new system of world economy ? The much discussed question of the importance of the small and large estate is not considered here, mainly because this problem, owing to extremely accurate investigations, because based on the inductive method of Professors BRDLIK and LAUR, has assumed an objective character, up to a certain point, and enables an opinion to be formed independently of social or political views. In relation to the present problem, it is sufficient to draw attention to the fact that, being self-sufficient from an economic point of view, mentioned above, will compel the various countries to constitute their agricultural systems in such a manner that all types of their farms are maintained in the quantity required for attaining optimum production according to the specialization of farms of different types, either of crop or stock production.

On the other hand, it may be pointed out that, in view of the agricultural revolution which is seen to-day, the small peasant farm has acquired a greater international importance in comparison with that of pre-war times.

The changed nature of that farm in the more backward countries, from an economic point of view, by means of the development of pecuniary elements, the raising of the standard of life and, in that way also, the connection of the farm by voluntary ties to the market, should be the principal care of the political economist, and it will be necessary to give to this subject not less attention than is given to the development of agricultural production itself, but this cannot be attained until after the solution of the first problem.

The production of small farmers, which up to the present has, in the West, kept to the type of production based on constraint, or having a patriarchal character (according to the distribution of production by types, introduced by a Polish economist M. Zawadzki) should be raised to a higher grade and transformed into a commercial production type — individualistic, characteristic of present economic life in West Europe, while retaining certain specific features resulting from its agricultural character. This end may be reached even by the development of the natural peasant farm into a pecuniary business, as the Russian economists Prokopowiez, Bruckus and others rightly state, contrary to those who support the theory of the artizan-peasant family, professed by Czajanow, Czelikeev, and others.

In order that the development referred to may be brought about M. Zaworli's theory of production requires the existence of the following conditions :—

(1) The individualist form of productive force in agriculture, that is to say the freeing of the small peasant farms from the bonds of common possession or agricultural constraint.

(2) The relation between production and economic activity, the perception of which cannot be awakened in the psychology of the small farmers except by means of a political economy which establishes, in an equitable manner, the relative prices of manufactured goods and agricultural produce, and which would assure the yield of these two branches of economic life.

(3) The awakening of the desire to work. This desire is however, always shown among farmers when the first two conditions are realized and when the family sense, as well as the sense of economy, strongly developed in country-life, based on the unshaken right of property, respected by the State, enables the fruits of work for the public welfare and future generations and consequently for the welfare of the whole of humanity, to be reaped.

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INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

THE INFLUENCE OF ELECTROLYTES ON THE ABSORPTION OF HYDROGEN IONS.

In a former article (1) a description is given of some experiments made to ascertain how electrolytes affected the absorption of ions of ammonium (*antagonistic* action of ions). These experiments showed that electrolytes very considerably reduce the absorption of ammonium ions, the strong acids the most (50-60 %), the neutral and acid reacting salts less, and least of all the alkali reacting salts, which in some cases increase the absorption (Table 1). The latter probably depends on the fact that the alkali reacting electrolytic solutions increase the dispersion of the basic particles.

The H ions have therefore very great supplanting properties, which correspond to the extremely weak hydration of H ions. As it was expected that the electrolytes would only have a feeble influence on the absorption of H ions, the following experiments were made :—

(1) B. Aarnio. Die Adsorption des Ammonium-ions aus Lösungen verschiedener Ammoniumsalze und die Einwirkung von Elektrolyten auf dieselbe. *Zeitschrift für Pflanzenernährung und Düngung*, Part A., Year 1, No. 5, 1922.

TABLE I. — *Absorption of NH_4 ions from a 0.1 N. solution, by clay soil.*

100 gm. soil absorb:					
from 0.1 N. $(NH_4)_2SO_4$ – solution			from 0.1 N. $(NH_4)_2HPO_4$ – solution		
without addition	absorbs 0.4154gm.NH_4	without addition	without addition	absorbs 0.6465gm.NH.	without addition
+ HCl 0.1 N.	0.1824 »	— 56.09 %	+ HCl 0.1 N.	0.2546 »	— 60.62 %
+ HNO_3 »	0.1896 »	— 54.36 »	+ HNO_3 »	0.2546 »	— 60.62 »
+ H_2SO_4 »	0.2258 »	— 45.64 »	+ H_2SO_4 »	0.2799 »	— 56.71 »
+ $Al_2(SO_4)_3$ »	0.2456 »	— 40.87 »	+ $Al_2(SO_4)_3$ »	0.3856 »	— 40.39 »
+ Mg SO_4 »	0.3449 »	— 16.97 »	+ $CaCl_2$ »	0.4623 »	— 28.49 »
+ $CaCl_2$ »	0.3598 »	— 13.57 »	+ $NaNo_3$ »	0.5129 »	— 20.66 »
+ $NaNo_3$ »	0.4038 »	— 12.57 »	—	—	—
+ Na_2CO_3 »	0.4812 »	— 15.84 »	+ Na_2CO_3 »	0.6014 »	— 6.98 »

Experiment I. — 10 gm. of heavy, neutral, glacial clay were treated with 100 gm. 0.01 N. HCl or H_2SO_4 respectively, and the concentration of hydrogen was determined electrometrically (according to L. MICHAELIS). In solutions of 0.01 N. HCl — and H_2SO_4 — employed, the P_H was 2.12 or 2.16. Then so many electrolytes were added (NaCl, K_2SO_4, $CaCl_2$) that the solution with respect to electrolytes was also 0.01 N. ; 10 gm. of clay were treated with this solution, and the P_H determined.

TABLE II. — *Absorption of H ions from* 0.01 *N. HCl and from H_2SO_4 solution, by glacial clay from S. W. Finland.*

	P_H		P_H
0.01 N. HCl (without addition)	4.04	0.01 N. H_2SO_4 (without addition)	4.00
» » + 0.01 n NaCl	4.04	» » + 0.01 n NaCl	3.96
» » + » » K_2SO_4	4.09	» » + » » K_2SO_4	4.05
» » + » » $CaCl_2$	3.89	» » + » » $CaCl_2$	3.85
» » + » » $MgCl_2$	3.81	» » + » » $MgCl_2$	4.00
Originally 0.01 N. HCl	2.12	Originally 0.01 N. H_2SO_4	2.16

Absorption of OH ions from 0.01 $Ca(OH)_2$ solution, by neutral glacial clay from S. W. Finland.

	P_H
0.01 N. $Ca(CH)_2$ (without addition)	9.03
» » + 0,01 n KCl	9.03
» » + » K_2SO_4	9.35
» » + » $CaCl_2$	8.84
Originally 0.01 N. Ca $(OH)_2$	11.34

Table 2 shows that the clay absorbs H ions very freely from solution 0.01 N., so that the concentration of the solution falls to about 0.0001 N. The elctrolytes used have hardly any antagonistic influence on the absorption of H ions. The H ions behave, therefore, very differently from the NH_4 ions with regard to absorption ; this might have been foreseen in the experiments with NH_4 ion absorption (Table I). From these experiments it appears that H ions are absorbed the most, and therefore supplant the other absorbed ions.

Experiment II. — 5 gm. of soil (neutral clay, sphagnum peat and acid clay) were treated with 50 cc. or 0.1, 0.001, 0.001, 0.0001, and 0.00001 normal HCl and NaOH, and the concentration of H ions determined.

TABLE III. — *Neutral clay from S. W. Finland (5 gm. soil + 50 cm. solution)*

	P_H		P_H
H_2O	7.19	H_2O	7.19
0.00001 N. HCl	7.15	0,00001 N. NaOH	7.19
0,0001 N. »	7.03	0,0001 N. »	7.15
0,001 N. »	6.64	0.001 N. »	7.34
0,01 N. »	4.48	0,01 N. »	10.04
0,1 N. »	1.59	0,1 N. »	12.18

TABLE IV. — *Sphagnum peat from S. W. Finland (5 gm. soil + 50 cc. soltion).*

	P_H		P_H
H_2O	4.73	H_2O	4.73
0.00001 N. HCl	4.62	0.00001 N. NaOH	4.73
0.0001 N. »	4.69	0.0001 N. »	4.78
0.001 N. »	4.58	0.001 N. »	4.97
0.01 N. »	3.60	0.01 N. »	5.36
0.1 N. »	1.69	0,1 N. »	7.59

TABLE V. — *Acid clay from S. W. Finland (5 gm. soil + 50 cc. solution).*

	P_H		P_H
H_2O	3.79	H_2O	3.79
0.00001 N. HCl	3.87	0.00001 N. NaOH	3.91
0.0001 N. »	3.75	0.0001 N. »	3.84
0.001 N. »	3.66	0.001 N. »	3.84
0.01 N. »	3.04	0.01 N. »	5.20
0.1 N. »	1.63	0.1 N. »	12.09

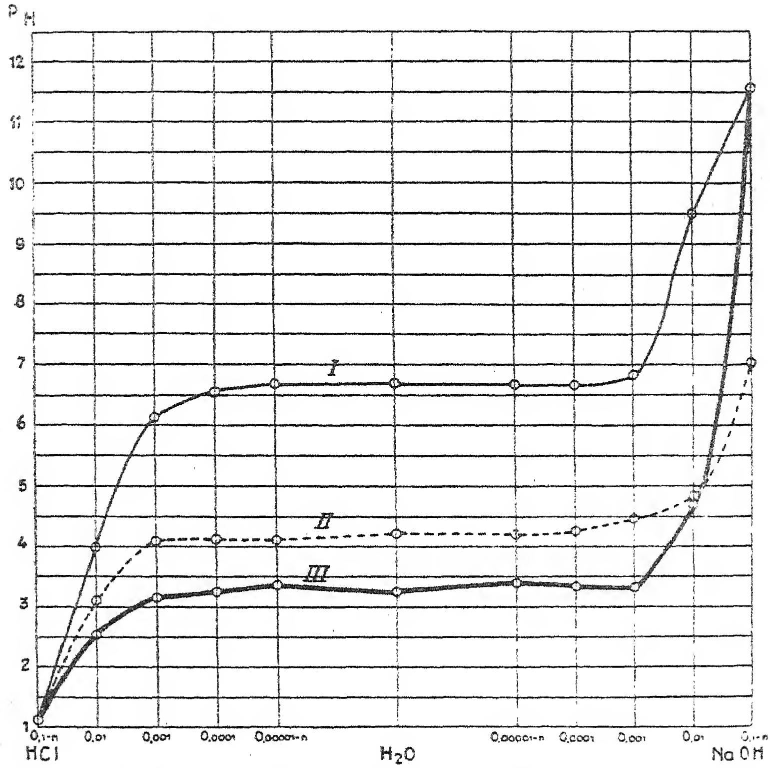

FIG. 6. — I. Neutral clay from S. W. Finland.
II. Sphagnum peat from S. Finland.
III. Acid clay (Litorina) from S. W. Finlands.

As appears from tables 3-5 and figure 6, the P_H remains almost constant on both sides of the water solution, independently of whether the clay is acid or neutral, until the concentration of the added acids or alkalis becomes 0.001 N. A 0.01 N. acid or alkaline has a strong effect on the clay; on the sphagnum peat the acid has a

considerable effect, but the alkali very little. A 0.1 N. acid solution reduced the P_H in all soils alike (P_H about 1.6). 0.1 N. alkaline also has an equally strong effect on the clay, so that the P_H becomes about 12. Sphagnum peat behaves quite otherwise, for with 0.1 N. alkali, the P_H only rises to 7.59. It may be assumed that the relatively strong alkali disintegrates the organic matter.

Experiment III. — The sphagnum peat was treated respectively with 0.1, 0.01, 0.001 and 0.0001 N. HCl and NaOH as before, with the addition of 0.01 N. KCl and $CaCl_2$ (the solution was therefore in relation to KCl and CaCl, 0.01 N.); the P_H was measured electrometrically. The results are shown in figure 7.

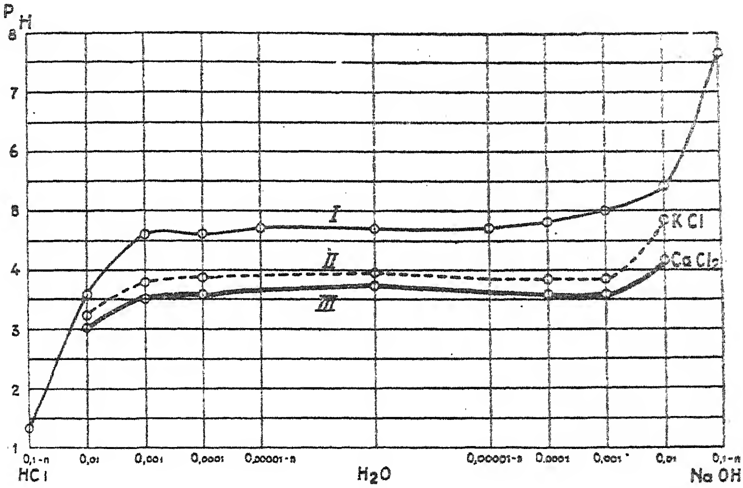

FIG. 7. — Sphagnum peat from S. Finland.

If curve I (without addition) be compared with curve II (HCl and NaOH + KCl) and curve III (HCl + $CaCl_2$ and NaOH + $CaCl_2$) it is seen that the electrolytes (0.01 N. KCl and $CaCl_2$) are almost entirely without influence on the H ions, because the pure KCl — and $CaCl_2$ — solutions exert an influence on the P_H equal to that of the 0.001, 0.001 N. HCl — and NaOH — solution with 0.01 N. KCl or $CaCl_2$.

Experiment IV. — Acid Litorina clay, paimio and silkkila were treated as in experiment III. From the results it appears that the 0.01 N. KCl and $CaCl_2$ solution had no influence on the absorption of H ions.

Experiment V. — Neutral glacial clay and loam were treated as in experiments III and IV.

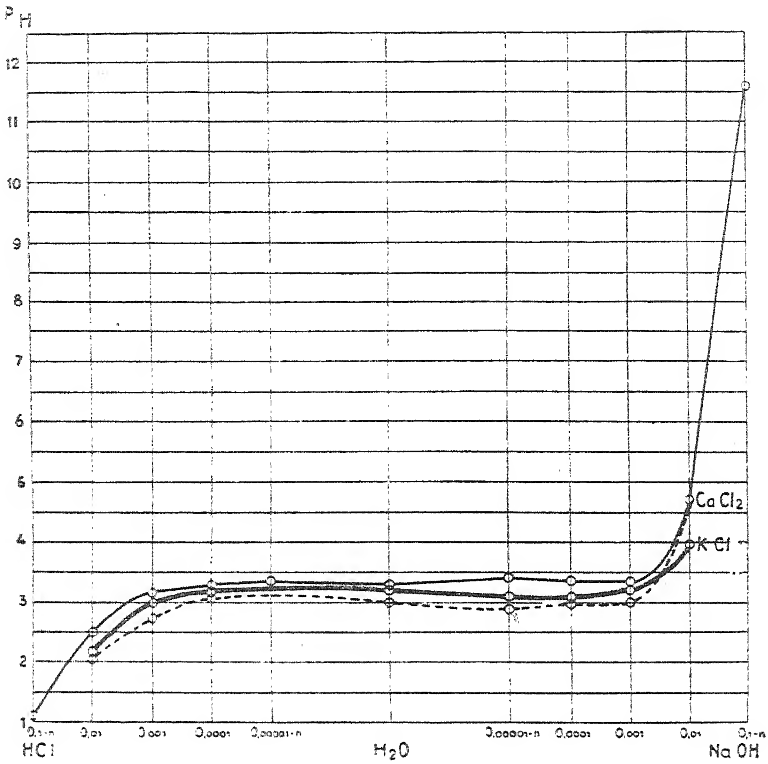

FIG. 8. — Acid clay (Litorina clay) from S. W. Finland.

With regard to these experiments, the conditions are the same as in experiments III and IV. The influence of pure 0.01 N. KCl and $CaCl_2$ solution on P_H is about the same; the rather weaker action of $CaCl_2$ solution is probably to be explained by the greater content of Ca ions of the neutral clays.

From the experiments it is shown that the electrolytes (0.01 N. KCl and $CaCl_2$) cannot expel the H ions from the clay. The phenomenon observed that the KCl solution gives rise to an increase of acidity in the soil solution (as compared with pure water solutions) cannot be caused by the K ions being interchanged with H ions, but that the K ions are interchanged with Al ions, and consequently the resulting aluminium compounds are hydrolysed.

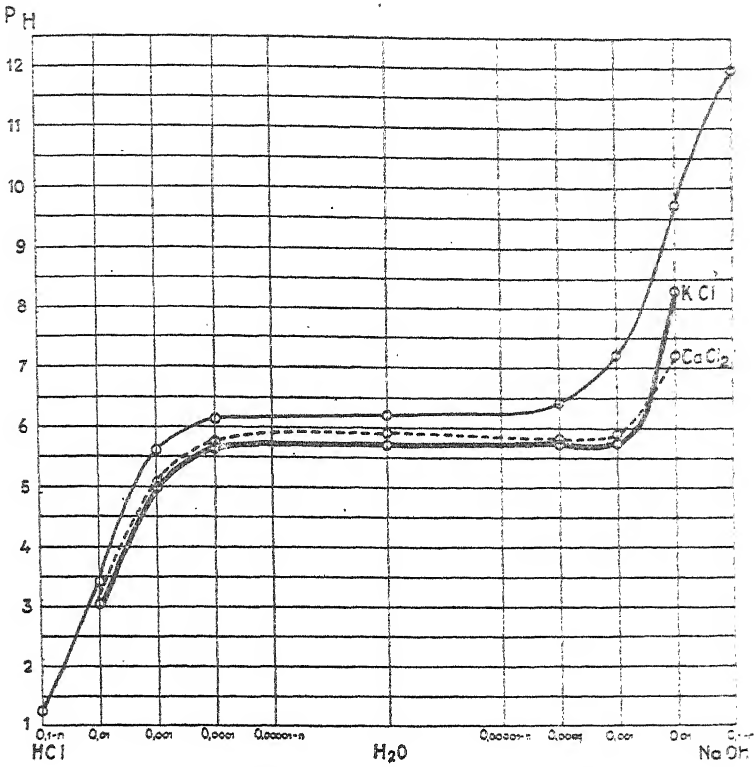

FIG. 9. — Neutral clay from S. W. Finland.

It is also clear that if the ions absorbed in a soil are to be determined, an acid must be used, because the H ions very strongly displace other ions (1).

B. AARNIO.
Helsinski.

(1) Compare G. WIEGNER : Dispersität und Basenaustausch. *Zsigmondy Festschrift, Jubelband der Kolloid-Zeitschrift*, p. 341, 1925.

METHODS OF PRACTICAL APPLICATION OF RESEARCH ON SOIL PHYSICS (1)

Soil, in conjunction with climate, forms the basis of all agriculture. For example, the choice of plants to be cultivated, rotation of crops, preparation of the ground, etc. will vary according as there is a light sandy soil, or a heavy clay soil. Consequently the soil, in the end, becomes the deciding factor in farm management and in financial success.

According to the proportion of the mixture of stones, sand, silt and clay, soils change from light soils rich in sand to heavy and very heavy clay soils. Different methods of examination, as for example those of KOPECKY, and KRAUSS, also the simpler ones of KUEHN, etc., make it possible to determine numerically the constituent parts of a soil. But to appreciate the important bearing which the values obtained have with regard to the dimensions of the particles, demands great experience and special knowledge, such as cannot yet be expected everywhere from the practical farmer. It is therefore desirable to find suitable methods, which would enable the farmer not acquainted with soil science to understand the results of the physical examination of the soil, and draw from them the conclusions bearing on his husbandry.

The author believes now, with Th. L. HENKEL, to have found a method which, taking as a basis the OSANN triangle modified by KOEHNE, facilitates bringing the results of physical examinations of soil into close connection with agricultural practice.

In the angles of the triangle (Fig. 10) lie the three extreme types of soil. As the soils, as a result of their composition, approach more nearly to the middle of the triangle, denoted by the circle, they become more and more like each other, and form the group of medium soils included in the large square. But of course even the medium soils are not all of the same value, and hence the recognition of the differences is an absolute necessity in practice. Therefore the medium soils in the large square are divided by the vertical dividing line into two

(1) See *Landw. Jahrbuch für Bayern VII-VIII*, p. 328, 1925.

groups, of which the left contains the lighter, and the right the heavier types of soil. The inserted arrow line points out in what manner the transmission from the lighter to the heavier soils is gradually accomplished. The upper part represents the most similar soils, whilst both ends of the arrow line approach the extremes, of sand and clay.

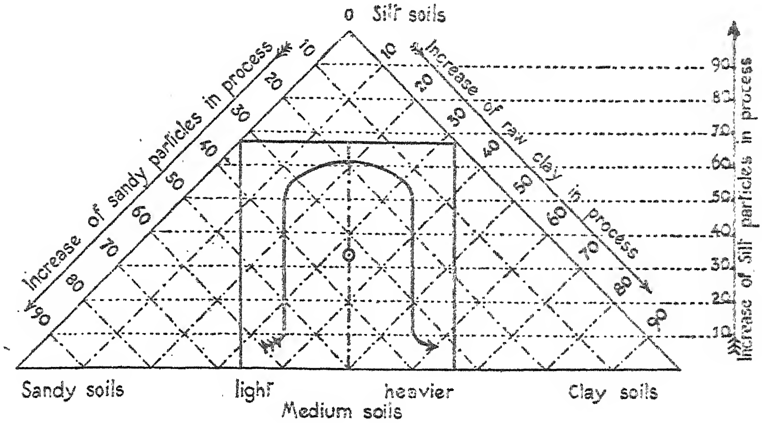

FIG. 10. — Diagram showing the results of the physical examination of a soil in practical agriculture.

This division of the soils into individual groups makes it possible to draw conclusions as to properties and applicability, if it is realised that specific properties are associated with sand, silt and raw clay. Figure 11. shows these, as also their effect on the transitional forms of the three types of soil.

Here again the best conditions lie on the centre line, which becomes the resultant of the play of forces of the different properties of soil.

Let it now be assumed that the soil consists of 60 % sand, 20 % silt, and 20 % clay. Figure 10. shows that this soil lies in the left lower point of the triangle, but still is no longer very far removed from the square of the medium soils. It still belongs, therefore, to the group of sandy soils, but comes very near to the medium soils. The extreme properties of the sand are still predominant, but are already modified. Its affinity to the sandy soils implies that it is fairly easy to till, that it will become warmed comparatively quickly in the spring, but as is shown by its nearness to the medium soils, it is perceptibly influenced by the action of the clay and silt. The

soil will therefore be able to exert some power of absorption on fertiliser salts, the permeability of water is no longer of such great account, etc. In the choice of crops to be cultivated it is still necessary to take into consideration those for light types of soil, but these will, with suitable cultivation, give good yields. It may already have been attempted, by careful preparation of the ground according to the conditions of the subsoil, to bring more important plants into cultivation, but with the heavy medium soils no very great success can be expected. This, after all, poor soil will not allow of expensive working equipment and intensive cultivation.

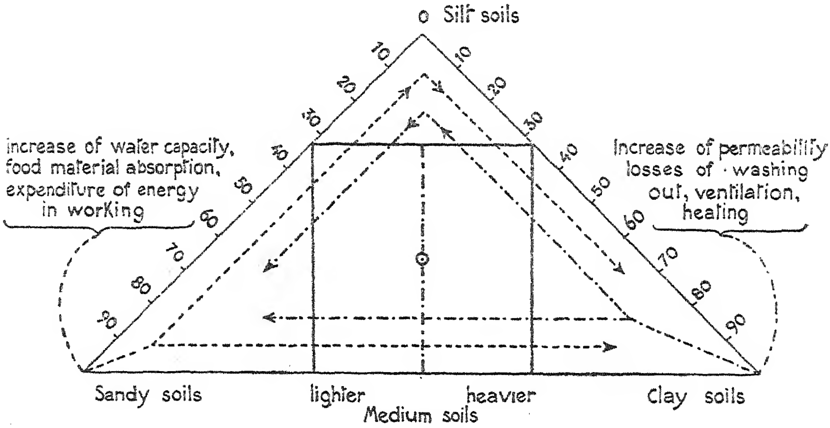

FIG. 11. — Diagram for ascertaining the properties and applicability of soils on the basis of a physical examination of the soil.

On the other hand, a soil which contains, for example, 30 % sand, 20 % silt and 50 % clay, lies in the lower part of the region of heavy medium soils. This soil, as the result of its proximity to clay, perhaps already possesses too much water-holding power, and in springtime will be rather later in getting warmed, on the other hand it has an exceptional capacity for absorption of plant food material, is considerably more easy to till than the true clay soils, etc. By proper cultivation it can also be made to give good crops, even with the more important plants. It can therefore be valued considerably higher than the soil of the first example.

A soil uniform in section has until now been taken as a basis. Many soils, however, show various layers to a depth of 1 m., par-

ticularly when they are considered for agricultural purposes. Thus a *sandy soil* may remain uniform to the depth mentioned, or may, below 50 cm., have a sub-layer of clay. In the first case the disadvantages, such as permeability, washing out of food material, etc., are more prominent than in the second. By *evenness* of the upper and lower soils, therefore, the extreme qualities are strengthened. In the second case, on the contrary, by the *opposite* conditions of the upper and lower soils, the extreme properties are mitigated. If a uniform *clay profile* continues unaltered, then the impermeability to water of the upper layer will also continue in the subsoil, whereas an under layer of sand carries off the deposit more easily. Here also, therefore, uniformity of profile strengthens the properties, whilst dissimilarity weakens them. *Silt soils* come between sand and clay, and therefore possess compensating physical and chemical properties; consequently a uniform profile is *most valable* here, for it will be understood that a substratum of one of the two other kinds of soil affects the silt soil less favourably. The medium soils comprised in the square are expressed by dashes — likewise more or less even. The underlaying of a medium soil by another can therefore exert no important influence, at all events it is much less than in the case of the above examples with regard to sand and clay. If one of the lighter medium soils, on the contrary, has a substratum of one of the soils found to the left of the middle dashes, then it will be of less value, the further away the subsoil lies from the middle line towards the left angle. The same applies similarly for the right half of the square of medium soils.

In Fig. 12. it is sought to make clear the far-reaching (therefore area-dimensional) conditions described here.

If the upper and lower soils fall on the left, sandy, or the right, clayey angle, then the conditions are extreme; if they lie together at the point or in the middle square, then they are more or less even. To the extent in which the upper or lower soils are removed from the centre line or the angles, the whole of the properties of the soils alter, now towards the bad, now towards the good side, as expressed by the arrows.

The examples given with reference to figure 10. can now be completed. If in the first example the soil lies in the sand angles, then the less favourable natural tendencies of the upper soil, inclining towards dryness, washing away of plant food material, etc., will be still further strengthened; the soil will be reduced in value. If,

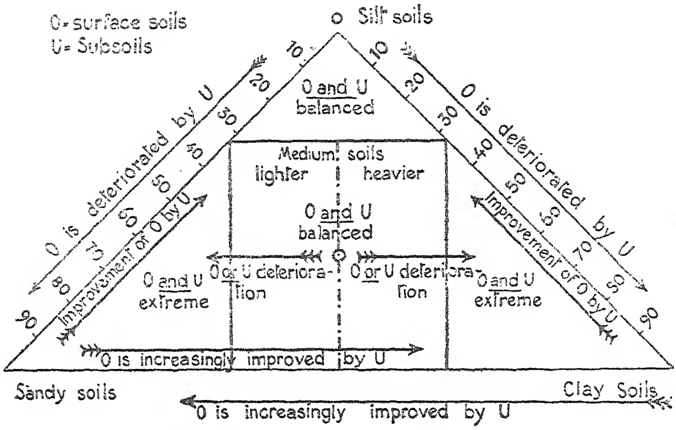

FIG. 12. — Diagram to explain the results of the physical examination of a soil for practical agriculture, in the case of soils with different layers.

however, the subsoil lies for example, in the right half of the square of medium soils, then it may be of considerably higher value.

Until now one constituent part of the soil has not been considered, namely, the stone content. In valuing this, the sizes of the stones must be taken into account. Thus, for example, the influence of a stone about the size of the fist cannot be compared with the same weight of stones of only the size of peas scattered through the soil. With a rising stone content, the soil, generally speaking, should be moved from the position in the triangle which its other physical analyses would give it, towards the left, lighter side.

Like all attempts to estimate the value of a soil according to a scheme, the foregoing has certain defects; still, the system here proposed may help even the practical farmer to inform himself quickly, on the basis of a simple examination, concerning any soil, and to recognise quickly its possibilities of usefulness.

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THE INFLUENCE OF ELECTROLYTES ON DIFFERENT TYPES OF SUSPENSIONS OF CLAY.

The literature on the influence of electrolytes on suspensions of clay is relatively extensive. An exhaustive survey of the literature is given by Prof. K. GEDROIZ (1) in his treatise which appeared in 1915, in which the literature is divided into ancient and modern. In the first group GEDROIZ included the works which were published up to the year 1893, that is, those periods in which the colloidal substances of the soil were only slightly known. Here appear the works of Fr. SCHULZE (2), SCHEERER (3), Ch. SCHLOESING (4), A. MAYER (5), E. HILGARD (6) and G. BODLAENDER (7). In these works important data were already collected, which gave a general idea of the influence of electrolytes on suspensions of clay, and also enabled certain of the suspensions to be more closely characterised.

Of the modern investigations GEDROIZ cited: the works of ROHLAND (8), MASCHHAUPT (9) and WIEGNER (10), ROHLAND considers the hydroxyl-ion as the most important factor in causing coagulation, which is contrary to the theory of FREUNDLICH (11), and which the last two named authors point out in their works. Prof. GEDROIZ is also of ths same opinion, which is based on his numerous tests. As the above-mentioned work by GEDROIZ may be considered as a continuation and amplification of the earlier investigations, it will be more closely considered, and also the method of the work.

I. IMPORTANT CONCLUSIONS DRAWN FROM THE INVESTIGATIONS OF GEDROIZ.

For the investigations, suspensions of red clay were used, which in the course of three days had not been deposited from water 7.5 cm. in depth. One litre of water contained 0.22 gm. of the clay particles. The tests were carried out in NESSLER's cylinders, and foı these were used 50 cc. of the suspension, and 50 cc. of the corresponding electrolytic solution, of which the influence on the clay suspension was to be investigated. The duration of the test was 48 hours, but already after 24 hours important results were obtained. In the

tests the highest concentrations were observed which produced no coagulation — these are termed by GEDROIZ, rising values — and the lowest concentrations were noted at which complete coagulation took place, *i. e.*, the particles of clay had all coagulated and had been deposited.

The results obtained by GEDROIZ are given in Table I, where the concentrations are expressed in relation to normal solutions.

TABLE I.

	Concentrations with which no coagulation is produced (rising values)			Concentration with which further complete coagulation is produced.		
Chloride of mercury $HgCl_2$	0.5	– 0.00025	Normal		—	Normal
Acetic acid	0.25	– 0.125	»	0.5	– 0.25	»
Citric acid	0.05	– 0.0125	»	0.125	– 0.05	»
Sodium hydrate	about	0.0225	»	about	0.05	»
Oxalic acid	under	0.025	»	under	0.5	»
Litium chloride	0.025	– 0.0125	»	0.125	– 0.050	»
Ammonium chloride	0.025	– 0.0125	»	0.125	– 0.050	»
Chloride of sodium	0.015	– 0.0125	»	0.125	– 0.050	»
Cloride of potassium	0.025	– 0.0125	»	0.125	– 0.050	»
Rhubidium chloride	0.0125	– 0.005	»	0.050	– 0.025	»
Formic acid	0.0125	– 0.005	»	0.1	– 0.050	»
Nitrate of silver	0.005	– 0.0025	»	0.025	– 0.0125	»
Orthophosphoric acid	0.005	– 0.0025	»	0.025	– 0.005	»
Nitric acid	0.0015	– 0.0005	»	0.005	– 0.0025	»
Sulphuric acid	0.0015	– 0.0005	»	0.005	– 0.0025	»
Magnesium chloride	0.00125	– 0.0005	»	0.005	– 0.0025	»
Chloride of manganese	0.00125	– 0.0005	»	0.005	– 0.0025	»
Calcium chloride	0.00125	– 0.0005	»	0.005	– 0.0025	»
Strontium chloride	0.00125	– 0.0005	»	0.005	– 0.0025	»
Chloride of nickel	0.00125	– 0.0005	»	0.005	– 0.0025	»
Chloride of cobalt	0.00125	– 0.0005	»	0.005	– 0.0025	»
Chloride of cadmium	0.00125	– 0.0005	»	0.005	– 0.0025	»
Chloride of barium	0.00125	– 0.0005	»	0.005	– 0.0025	»
Hydrocheric acid	0.001	– 0.0005	»	0.005	– 0.0025	»
Hydroxide of calcium	0.001	– 0.0005	»	0.004	– 0.0020	»
Protochloride of copper $CuCl_2$	0.0005	– 0.00025	»	0.0025	– 0.00125	»
Perchloride of iron, $FeCl_2$	about	0.000125	»	0.0005	– 0.00025	»
Chloride of aluminium, $AlCl_2$	»	0.000125	»	about	0.00025	»

The table shows that the organic acids in general possess very weak coagulative capacity ; the phosphoric acids, among the mineral acids, also possess only a weak coagulative capacity, whereas the so-called strong acids, *i. e.*, the strong dissociated mineral acids, such as sulphuric acid, nitric acid and hydrochloric acid possess a strong coagulative capacity.

Of the hydrates only the sodium and calcium hydroxides were examined. The coagulation capacity of the former is very weak (complete deposition can only be attained by a concentration of 0.5 N) whilst the latter possesses an exceptionally strong coagulative capacity ; even concentrations of 0.004 bring about complete coagulation of the clay suspension.

If we leave on one side the chloride of mercury, then the coagulative capacities of the acids stand in close association with the atomicity of the cations. The acids of the non-atomic cations produce coagulation only with relatively high concentrations ; the acids of the di-atomic cations are effective in more dilute concentrations ; but the coagulative capacity is especially strong with the tri-atomic cations — iron (12) and aluminium salts.

In addition to the investigations mentioned, Prof. GEDROIZ has examined the influence of sulphuric acid on the coagulative capacity of salts. It has been found that very weak concentrations of sulphuric acid, which of themselves can cause no coagulation of the clay suspensions, strengthen the coagulative capacity of the salts in a high degree. Such concentrations of chloride of sodium and chloride of potassium were investigated, which of themselves cause no coagulation of the clay suspensions. Thus, for example, a solution of chloride of sodium of the concentration of 0.0125 N. gave no coagulation of the clay suspensions in 48 hours, but if to the same solution sulphuric acid in the concentration of 0.001-0.000075 N. were added, then the clay suspension after 20 minutes was already flocculated and deposited. No coagulation was caused by weaker concentrations of sulphuric acid. The same result was obtained with chloride of potassium solution, with which also the concentration of chloride of potassium (0.0005 N.) by itself alone could cause no flocculation in 48 hours.

The influence of sodium hydrate on the flocculation of clay suspensions, with the presence of neutral salts in the solution at the same time, is much more complicated. With low concentrations of sodium hydrate (0.005 N.) the coagulation which was caused by higher concentration of chloride of sodium (0.15 N.) was strengthened ; the same concentration of sodium hydrate, however, with weaker concentrations of chloride of sodium, of 0.1 N. onwards, caused a noticeable retardation of coagulation. The solution of chloride of sodium of the concentration 0.015 N. caused by itself relatively great coagulation and a deposit in 48 hours. If, however, sodium

hydrate were present in the solution at the same time, then the coagulation with concentrations of sodium hydrate of 0.05-0.0125 N. could still be observed, whilst weaker concentrations of sodium hydrate (0.005-0.00025 N.) much retarded the coagulation, and only with concentrations of NaOH of 0.000025 N. was no retardation to be observed.

The soda solution exercised a still greater retarding action on the coagulation of the clay suspensions by the chloride of sodium. A concentration of 0.015 N. still caused comparatively strong coagulation, but if to this chloride of sodium solution was added soda in the concentration of 0.0125-0.00005 N., then no coagulation could be noticed.

The influence of the sodium hydrate on the flocculation brought about by chloride of potassium was the same, in the experiments of GEDROIZ, as he had shown with chloride of sodium solutions.

The influence of the sodium hydrate on the flocculating capacity of the chloride of potassium was different. The chloride of potassium solutions in the concentration of 0.001 N. in 48 hours already caused considerable coagulation; by the addition of sodium hydrate in the concentrations 0.001-0.00025 N. the coagulation was strengthsened. Coagulation was retarded by the addifion of sodium hydrate in weaker concentrations (0.000125-0.0000125 N.), but the retarding action was no longer noticed with a concentration of 0.000005 N. By the addition of sodium hydrate to a chloride of potassium solution, therefore, with weak concentiations of the sodium hydrate, the coagulation is still further strengthened, and only concentrations of sodium hydrate of 0.000125 N. retard coagulation, or exert no further influence.

In the further experiments of GEDROIZ on the influence of sodium hydrate on the coagulation of clay suspension by $Ca(OH)_2$ no retarding action was observed. GEDROIZ draws from his experiments the conclusion that coagulation is caused principally by the cation, the anion operates in an opposite direction, with which the operation of the OH' ions is especially strong. The latter is especially active in solution with mon-atomic cations, whereas the coagulation capacity of the diatomic cations (*e. g.* Ca $(OH)_2$) is stronger than the stabilised action of the OH' ions.

GEDROIZ has also investigated the coagulative capacity of NaOH, Na_2CO_3 and $NaHCO_3$, and found that the greatest coagulative

capacity of the first becomes the weakest of the last, as is seen from the following data.

	No coagulation between	Complete coogulation
$Na\,OH$	— 0.023 — 0.020 N.	0.100 — 0.050 N.
$Na_2\,CO_3$	— 0.05 — 0.025 »	0.125 »
$Na\,HCO_3$	— 0.125 — 0.05 »	0.125 »

The $NaHCO_3$ is considered by GEDROIZ as diatomic.

The influence of various calcium salts on clay suspensions was almost equally great; quick-lime had the highest coagulative capacity amongst them. The concentrations of the calcium salts, with which no coagulation was brought about (the electrolytic rising-value) were as follows :—

$CaCl_2$	0.00125 —	0.0005 N.
$Ca(NO_3)_2$	under	0.00125 »
$Ca\ (OH)_2$	0.001 —	0.0005 »
$CaSO_4$	under	0.000125 »
$Ca\ (HCO_3)_2$	»	0.00125 »

The following experiment of GEDROIZ is of interest, characterising in detail the influence of electrolytes on the coagulated clay particles. After the deposition of the coagulated particles of clay, the clear solution was poured off, and in its place pure distilled water added. If coagulation were produced by chloride of sodium, then the coagulation, by reducing the concentration of the salts, was again broken off.

If the coagulation was produced by hydrochloric acid, chloride of potassium and chloride of barium, then, by reduction of the concentration of the coagulator to such an extent that no further coagulation took place, only a small part of the coagulated particles were again made free.

If, however, the coagulation was produced by $FeCl_3$, then the coagulation could no longer be arrested, even though the liquid over the coagulated deposit were poured off 5 times and replaced with pure distilled water.

It has therefore been shown that the dispersed particles, under the influence of the mon-atomic Na' ions as coagulator, have not lost their capacity for increasing dispersiveness, that is, by reducing

the concentration of the coagulator, all the coagulated particles are again dispersed, and coagulation can therefore be made reversible.

If coagulation is brought about by the H ion (hydrochloric acid) or the diatomic cations Ca'' and Ba'', then the dispersiveness in the distilled water is indeed increased, but in a much less degree than in the first case. The influence of the triatomic cations is much greater in this respect; the coagulation can scarcely be made reversible by distilled water.

GEDROIZ further took into consideration the relations between the size of the particles and the concentration of the coagulator. With this he has established that, the finer the particles, the higher must be the concentration of the coagulator in order to bring about coagulation. However, the relations with high concentrations of the electrolytes, which in a very short time produce coagulation, are rather different — the finer particles are flocculated out with lower concentrations than the coarser particles.

Also, the concentration of the clay particles in the solution has a certain significance; coagulation takes place considerably more quickly with a higher content of dispersed particles. This condition has been observed both with high and low concentrations of electrolytes.

Prof. RAMANN (13) quotes some data on the coagulation of quartz suspensions, which unfortunately are not comparable with the data of GEDROIZ. Quick-lime has also been shown by the experiments of Prof. RAMANN to be a very quick coagulator, having caused coagulation with a concentration of 0.00035 N., that is, with a content of 0.013 gm. to the litre. The influence of quick-lime was 300 times greater than the influence of sodium oxide, and 245 times as great as the influence of carbonate of soda. Prof. RAMANN is also of the opinion that the physical qualities of the soils are in intimate relation with the coagulation phenomena.

Some data relative to the influence of $Ca(OH)_2$ on the finest particles of soil are found in the investigation of Prof. O. LEMMERMANN and L. FRESENIUS (14), in which it is shown that in weaker concentrations $Ca(OH)_2$ can also have a retarding action on the coagulation of suspensions.

The above investigations, including the exhaustive investigations of GEDROIZ, give no explanation why the physical qualities of soils, even with the podsol formation of clay soils, are so quickly altered. According to the investigations of GEDROIZ, podsol clay soils contain extremely small quantities of absorbed cations, apart from the H ion,

but the coagulation capacity of the latter is comparatively high. Moreover, it must also be assumed that a certain quantity of H ions are formed in podsol clay soils by washing out reaction, which has in fact been observed from many methods of determining the lime requirements of the soil. Even very small concentrations of H_2SO_4 of 0.000075 N. and over, have assisted coagulation in the investigations of Prof. GEDROIZ. From other investigations of Prof. GEDROIZ it has been shown that the dispersiveness of the soil is very much raised by replacing Ca'' by H'.

The properties of clay which has been exposed for a long time to the action of water are quite unexplained. It is known from practice that even the physical qualities of marl clay become very bad after the continued action of water, quite apart from loams having no $CaCO_3$, which at the same time contain the absorbed H' ions of clay-loam. GEDROIZ points out finally that water saturated with $CaCO_3$, but containing no CO_2, exerted no influence on the coagulation of the clay suspension which was obtained from the clay investigated. Theoretical considerations, however, show that if $CaCO_3$ is contained in the clay particles, with at the same time other electrolytes which assist or retard the dissociation of the $CaCO_3$, this influence must be very great.

It is well known from practice that even from the poor soils of Lettland with acid reaction, very light clay suspensions can be obtained. Such soils usually require larger quantities of manure, and require manuring more often than the neutral soils, which are also associated with the properties of the finest particles of these soils and their relation to electrolytes.

I. EXPERIMENTS WITH CLAY SUSPENSIONS MADE FROM THE LOAMS OF LETTLAND.

The main object of the investigation was:

(1) To ascertain the concentrations of electrolytes which cause coagulation of the suspensions of different kinds of clay, under the influence of Na' and Ca'' salts, sulphuric acid, carbonic acid, and also various mixtures of salts.

(2) To determine in detail the association of the related clay suspensions, especially in regard to the cations absorbed.

Various causes of delay occurred, however, in carrying out the investigation, consequently it could not be carried out so completely

as was intended. As in the results obtained the influence of the acid reaction of the soil, and the importance of the calcium carbonate with regard to the phenomena of coagulation, were clearly shown, the investigation will probably be of interest to those who study soil structure.

The experiments were carried out with clay suspensions of the following soils :—

(1) Clay-loam formed under the influence of excessive wet. It contains no calcium carbonate, shows very strong acid reaction, and has very inferior physical qualities.

The three following horizons of a podsol clay soil, formed on heavy rubble-loam :

(2) Upper level *A*, of bright grey colour and strong acid reaction.

(3) Brown loam, level *B*, especially rich in the finest particles. It contains no $CaCO_3$ and has a weak acid ıeaction with litmus paper.

(4) Marl loam, has a feeble alkaline reaction with litmus paper. Level *C*.

(5) Suspensions of original chalk — a relatively pure $CaCO_3$ suspension.

A detailed account of the testing materials will be given below after the description of the experiments.

The particles of clay used in the experiments were obtained from air-dry soil, dried in the room, without baking, or the application of any reagents. The soil was pulverized, granulated through a 1mm. sieve, and then various fractions of clay obtained by cleaning. First that fraction was recovered which had not been deposited in 24 hours from water 10 cc. in depth. At the same time several beakers were filled, each with 100 gm. soil and 500 cc. water, and decantation was carried out 8-10 times. From the fraction of clay obtained in this manner, particles of clay were isolated, which had not deposited from water 10 cc. in depth in the course of 72 hours. This somewhat complicated process had to be followed on account of the marl loam, as this at first supplied no portion which could be cleared of mud, and the original chalk showed the same condition. After the marl loam and original chalk had been treated longer with water, particles susceptible of being cleared of mud were obtained, which, however, deposited comparatively quickly, that is, in the course of 4-5 days. The examination of the clear liquid over the

deposited fractions of clay of this kind of soil showed that in the liquid fairly large quantities of Ca $(HCO_3)_2$ had formed, which had also caused coagulation. The experiments lasted several months. Also, the finest products of the marl loam had deposited several times during this period, and each time the clear liquid was poured off, and replaced by distilled water. The following experiment shows how great is the influence of the water, which had already been standing for a long time over the finest products of the marl loam, on the mechanical composition of the fraction of clay (finest products).

From those clay fractions of the marl loam which had not yet deposited in the course of 10 days, the clear liquid was poured off; the residue was freed from mud, and each 25 cc. pipetted three times. This volume of the clay fraction contained 2.21 gm. of dry residue. With this clay fraction, without drying it, the mechanical analysis was carried out. For the analysis there were used (1) distilled water, (2) water which had stood for 10 days over the clay fraction of the marl clay, and (3) water which had stood as long as 60 days over the clay fraction and had become relatively harder.

TABLE II. — *Mechanical composition.*

	Deposits in 6 hours	Deposits in between 6-24 hours	Deposits in 24 hours
I.	21.2 %	40.4 %	38.4 %
II.	53.1 %	46.7 %	0.2 %
III.	96.2 %	3.7 %	0.1 %

It is seen that the alteration of the mechanical composition proceeds proportionately in stages—first the finest products disappear, and afterwards, when the water has become harder, the quantity of those particles which deposited in between 6-24 hours, is quickly reduced. From this test we see that the finest products of the marl clay cannot be obtained by mechanical analysis, even with distilled water, if the deposit of the products requires several days. A part of the finest products becomes no more dispersive by the use of the distilled water, since even in the first experiment 21.2 % of particles were available, which deposited in the course of 6 hours.

An analysis of the water used for experiments II and III, for its content of $Ca(HCO_3)_2$ and $NaHCO_3$ (16), showed:

II.

$Ca(HCO_3)_2$ . .	0.0009 N	0.073 gm. per litre
$NaHCO_3$ . . .	0.0002 »	0.017 » » »

III.

$Ca(HCO_3)_2$ . .	0.0015 »	0.121 » » »
$NaHCO_3$ . . .	0.0003 »	0.025 » » »

It should be remarked that $Ca(HCO_3)_2$ is reckoned as a diatomic, but $NaHCO_3$ as a mon-atomic salt, since the number of the $CO'_3{}'$ ions at the dissociation is very small, we have in the solution mainly the mon-atomic $HCO_3{}'$ anion. It is shown later that concentrations of this salt, of the amount found, can already exert considerable coagulating influence on the finest products.

The recovery of the finest products of the original chalk was also difficult. Only one out of several samples of original chalk gave such fine products that they did not deposit in the course of about 10 days, but even in this sample the deposit was complete after the expiration of 20 days, and only by the removal of the clear liquid standing over it, and the addition of fresh distilled water, was the suspension obtained again.

An attempt was also made to obtain suspensions of the finest particles from calcium precipitate. Although the mechanical composition in a few samples of chalk showed a relatively high content of the finest products, yet complete deposit in all the samples was very quick, and lasted no longer than one hour from a layer of water 15 cm. deep. A thorough examination showed that a fairly energetic hydrolytic decomposition of $CaCO_3$ takes place, and fairly large quantities of $Ca(OH)_2$ form in the solution. The concentration of $Ca(OH)_2$ was in some cases even 0.0016 N. which must also be taken as the main reason why, from $CACO_3$ precipitate, no suspension of the finest particles could be obtained. In another article I will go more closely into the question of the hydrolytic decomposition of $CaCO_3$, andespecially as to the factors which are favourable to the decomposi-tio, and those wh ich retard it, because this phenomenon also may have great influence on the physical qualities of the soil.

The concentration of clay suspensions of the above-mentioned soils was as follows :—

(1)	Loam-clay soil	4.43 gm. per litre
(2)	Podsol clay soil, level A . .	2.76 » » »
(3)	» » » » B . . .	1.56 » » »
(4)	» » » » C . . .	3.24 » » »
(5)	Original chalk	0.34 » » »

The experiments were carried out in test tubes of Jena glass. For each test 10 or 15 cc. of the suspension were used, and the same, or twice as great a volume added of the solution to be examined ; the concentration of the solution is expressed in terms of normal solutions, which occur according to the mixture of the solution with the suspension. I have not considered it important to have the concentration of the suspension equally great in all the experiments, as according to the investigations of GEDROIZ, it is not the concentration of the suspension, but rather the degree of dispersiveness, which has the greatest significance.

The observations were made at short intervals during the first 9 to 8 hours, and afterwards after 24 and 28 hours. The general formation was already quite clear after 24 hours, just as in the experiments of GEDROIZ, but in rare cases alterations were observed after the expiration of 24 hours. In several cases I have thoroughly shaken the tubes after 2 and several days, and repeated the observations, but very rarely found any difference. In all the experiments also, clay suspensions were used without any reagent, diluted with corresponding quantities of distilled water. In the great majority of cases two similar cylinders were used. It should be mentioned that the clay suspension, which had not deposited any particles of soil in 2 hours, after 24 hours, however, gave a small deposit at the bottom of the control cylinder. If the clay suspension is flocculated, however, even though slightly, then the deposit covers the whole of the bottom.

I shall here give only the most important results, that is, only the lowest concentrations, which produce complete flocculation in 24 hours, and the highest concentrations, which cause no flocculation (electrolytic rising value).

(1) *Sulphuric acid.*

Concentrations of 0.0001 N-0.005 N. were examined. The action was strong, the results were quite definite after 6 hours ; after 24 hours no alterations were to be observed. The suspended particles of original chalk all passed over into solution with concentrations

of sulphuric acid of 0.002 N. and higher. The results can be seen from table III.

TABLE III. — *Concentration of normal sulphuric acid :*

	Complete coagulation	No coagulation
Clay suspension of Loam-clay soil	0.002 N and over	0.0005 N. and under
Podsol clay soil, Horizon A	0.002 » » »	0.0005 » » »
» » » » B	0.001 » » »	0.0003 » » »
» » » » C	0.005 » » »	0,0001 » » »
Original chalk	0.001 » » »	0.0003 » » »

The data quoted show that the clay suspension of the marl loam (horizon C) is especially sensitive to sulphuric acid.

The following tests were also made with the clay suspension of the loam-clay soil and the upper horizon (A) of the potter's clay soil: 10 gm. of the dry soil were mixed directly with 10 cc. of sulphuric acid of different concentrations. The concentration of sulphuric acid with which complete flocculation took place was in this case rather higher — for both soils 0.003 N.; after 24 hours, however, the action was almost complete even with the concentration of 0.002 N. To the same cylinder, after flocculation, another 20 cc. of distilled water was added, which reduced the concentration of the acid by a third, and now began an increase of dispersiveness of the coagulated particles. In the cylinders with sulphuric acid of the concentration 0.0007 and lower, the quantity of dispersed particles was approximately the same as in the tubes with soil in distilled water. The coagulation and peptisation of the suspension is therefore a reversible process in the soils mentioned. GEDROIZ, in his investigations with hydrochloric acid, could only bring about incomplete peptisation.

(2) *Experiments with carbonic acid gas* (CO_2).

Distilled water containing 0.98 gm. CO_2 to the litre was used. If to 15 cc. of the clay suspension 15 cc. of the water containing carbonic acid were added, then the concentration of carbonic acid was 0.44 gm. to the litre, or say 0.01 N, if we assume that the CO_2 in the more dilute solution is dissociated from H'-HCO_3'. The clay suspension of the loam-clay soil and of the upper horizon (A) of the podsol clay soil gave no deposit with the 0.01 N. solution

of carbonic acid; the clay suspension of horizon B, with the same solution, gave a weak deposit, but with the concentration of 0.005 N. no deposit. The other two samples of clay suspension showed the following results :—

	Complete flocculation	No flocculation
Suspension of horizon C. of the podsol clay soil	0.001 N. and over	0.001 N. and under
Suspension of original chalk.	0.002 N. » »	0.0003 N. » »

The suspension of the finest particles of original chalk went completely into solution in this case also with concentrations which were greater than 0.0003 N. It is veiy characteristic that the clay suspension of the marl clay is much more sensitive to carbonic acid than the suspension of the pure original chalk. This phenomenon must be connected with the suspension — the concentration of the suspension of the marl clay was much greater.

To the cylinders with the clay suspensions of the loam-clay soil and horizons A and B of the podsol clay soil were added, after 24 hours, 0.5 gm. $CaCO_3$, as original chalk. Although the concentration of the carbonic acid had become weaker, the influence of the carbonic acid was considerably raised by this addition. With it the coagulation of the clay suspension of the loam-clay soil was almost complete, as can be seen from the following data :—

	Complete coagulation	No coagulation
Clay suspension of loam-clay soil.	over 0.01	0.003 N. and under
» » » horizon A.	» 0.01	0.002 N. » »
» » » » B.	» 0.004	0.0005 N. » »

10 gm. loam-clay soil and 10 gm. of the horizon A were each mixed with 1.0 gm. $CaCO_3$ in other cylinders, and distilled water without CO_2 added. The coagulation of the clay particles in this case also proceeded quickly — in six hours. After renewing the distilled water, no peptisation of the finest particles was observed.

From the experiments on the influence of distilled water containing carbonic acid, it can further be remarked that the deposit of the finest particles shows near relationship to the chalk contents of the soil: if no $CaCO_3$ is available in the soil, then either no, or an incomplete flocculation and deposit takes place. Such water can therefore be used as a reagent in the qualitative testing of the lime requirements.

It is characteristic that the concentration of carbonic acid, which produces a complete flocculation of the clay suspension of the marl-loam (0.001 N.), is only twice as low as the corresponding concentration of sulphuric acid, yet the electrolytic rising-value for both these acids is equally high (with the concentration 0.0001 N.). If we take into consideration that the carbonic acid has expelled sulphuric acid from the $CaCO_3$, then it follows from this that the action of the carbonic acid is not weaker, but stronger, than that of the sulphuric acid.

(3) *Experiments with $Ca(OH)_2$.*

The experiments were carried out with concentrations of 0.0001 N.-0.005 N. In all these experiments the results were quite definite after 6 hours, and no further differences occurred between 6-48 hours.

The following results were obtained :—

TABLE IV

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil	0.005 N and over	0.002 N and under
» » » podsol clay soil horizon A	0.003 » » »	0.005 » » »
» » » » » » » B	0.002 » » »	0.0003 » » »
» » » » » » » C	0.002 » » »	0.0005 » » »
Suspension of original chalk	0.002 « « «	0.0003 » » »

It is surprising that with the flocculation caused by $Ca(OH)_2$ no great differences of the operating concentration could be observed, as with the other electrolytes examined. The clay suspension of horizon B is even rather more sensitive to $Ca(OH)_2$ than the clay suspension of the marl loam.

The clear liquid over the deposit in the test cylinders was almost completely poured off, and distilled water again added. The clay suspension of the loam-clay soil in this case gave no deposit at all; the deposit in all the other test tubes was fairly large, but complete flocculation only took place in the cylinders with clay suspension of marl loam and horizon B, in which the original concentration of the $Ca(OH)_2$ amounted to 0.005 N. and over. Complete peptisation, however, could not be observed in any of the soils used, except in the clay suspensions of loam-clay soil, even after the addition of larger quantities of water.

(4) *Experiments with NaOH.*

The experiments were carried out with concentrations 0.003 N.—0.5 N., and the following results were obtained :—

TABLE V.

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil.	0.3 N and over	0.05 N and under
» » » potter's clay soil level A.	0.2 » » »	0.02 » » »
» » » » » » » B.	0.03 » » »	0.005 » » »
» » » » » » » C.	0.02 » « »	0.003 » » »
» » of level C of another sampler of soil	0.02 » » »	0.003 « « «

From the data quoted it appears that flocculation of the loam-clay soil and of horizon A of the podsol clay soil occurs with 10-15 times higher concentrations than does the flocculation of the clay suspensions of the marl loam. In order to prove the results obtained, clay suspensions of marl loam were also prepared from another sample of soil, which also proved to be equally sensitive to NaOH. It is probable that in this case the Na' ion is not of such great importance as the calcium ion passed over from the marl loam. It is also characteristic that the clay suspensions of loam-clay soil with concentrations of NaOH of 0.3 N.-0.05 N., viz. : suspensions of horizon A of the podsol clay soil, of 0.2 N.-0.02 N., in other words with those concentrations with which coagulation was in no way complete, showed a graded distribution of the solid particles, with respect to which 3 to 4 stages could be distinguished. This result was not obtained with the incomplete flocculation of the clay suspensions of the marl loam.

(5) *Experiments with $NaHCO_3$.*

As already stated above, the $NaHCO_3$ is considered as a monatomic salt. Ths experiments were carried out with concentrations of 0.001 N.-0.5 N., and the following results were obtained :—

TABLE VI.

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil.	0.4 N and over	0.05 N and under
» » » horizon A	0.3 » » »	0.01 » » »
» » » » B	0.1 » » »	0.02 » » »
» » » » C	0.03 » » »	0.002 » » »
» » original chalk	0.03 » » »	0.005 » » »

It may be remarked that $NaHCO_3$ acts less strongly than NaOH which is also confirmed by the experiments of GEDROIZ.

In comparing the results it must be borne in mind that the $NaHCO_3$ of Prof. GEDROIZ is assumed to be diatomic. The action of the $NaHCO_3$ is much stronger on the clay suspensions of marl loam and original chalk than on the other clay suspensions examined. The clay suspension of the loam-clay soil demands especially high concentrations for complete flocculation. After 48 hours, therefore, and the completion of the experiment, there was added to each of these clay suspensions 0.5 gm. $CaCO_3$ in a test tube. The flocculation capacity of the $NaHCO_3$ on the loam-clay suspension was not strengthened in this case, as was the case in the experiment with water containing carbonic acid. A closer examination of this phenomenon showed that the hydrolytic decomposition of the $CaCO_3$ was very much reduced by $NaHCO_3$, as both salts have the same anions.

(6) *Experiments with NaCl.*

Concentrations of 0.0005-0.5 N. were examined, and the followng results obtained :—

TABLE VII.

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil. . . .	0.2 N. and over	0.02 N. and under
» » » horizon A.	0.2 » » »	0.005 » » »
» » » » B.	0.02 » » »	0.003 » » »
» » » » C.	0.01 » » »	0.0005 » » »
» » » original chalk. . . .	0.02 » » »	0.002 » » »

Here also the strong action of the chloride of sodium on the clay suspensions of the marl loam, and especially the great difference between the concentrations which cause complete flocculation and no flocculation, is striking. In the experiments with chloride of sodium, the deposition proceeded much more slowly than with the other electrolytes tried ; during 24-48 hours considerable alterations could still be observed, which in the clay suspensions of the loam-clay soil and horizon A of the podsol clay soil were not nearly so grealta in the clay suspension of the marl loam. The explanation of this result must be sought in the influence of the NaCl on the hydrolytic decomposition of the $CaCO_3$ and the further dissociation of the pros

ducts of this decomposition. NaCl contains no ions common to $CaCO_3$ consequently the hydrolytic decomposition of the $CaCO_3$, under the influence of the NaCl, proceeds more quickly. If $CaCO_3$ precipitate alone is added to with a chloride of sodium solution, then perceptible quantities of the $Ca(OH)_2$ in a short time go into solution according to the equation :

$$CaCO_3 + 2\ H_2O = Ca\ (OH)_2 + H_2CO_3$$

The $Ca(OH)_2$ is strongly dissociated into Ca'' and OH' ; ions H_2CO_3, howevei, dissociates very easily into H_2O and CO_2 and only forms small quantities of ions H' + HCO_3' therefore a strong alkaline reaction in the solution can be shown with phenol-phtaline as indicator, and it can be easily shown that the solution contains $Ca(OH)_2$, and only very small quantities of Na_2CO_3, $NaHCO_3$ and $Ca(HCO_3)_2$. As, however, the hydrolytic decomposition in this case belongs to the slowly-progressing reactions (heterogeneous system), then probably on this account the difference in the concentrations which produce complete and no coagulation may be dissimilar ; the former concentration is about 20 times greater than the latter, which was not the case with the electrolytes observed previously. The balance, in this case, can only be established after a long time.

(7) *Experiments with $CaSO_4$.*

The experiments were carried out with concentrations of 0.0003 N. -0.01 N.

TABLE VIII.

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil	0.005 N. and over	0.001 N. and under
» » » horizon A of podsol clay soil	0.005 » » »	0.0005 » » »
» » » » B » » »	0.003 » » »	0.0003 » » »
» » » » C » » »	0.001 « » »	?
» » » original chalk	0.002 » » »	0,0003 » » »

The clay suspension of the marl loam, with a concentration of gypsum of 0.0003 N., in 6 hours gave no deposit ; after 24 hours

there was a slight deposit, and after 48 hours a fairly heavy one. Therefore, the concentration which produces no deposit is less than 0.0003. N., probably 0.0001 N.

The lowest concentrations of gypsum, which will cause a complete flocculation of the clay suspensions, are about twice as high as the corresponding concentrations of sulphuric acid — the action of the latter is therefore stronger.

(8) *Experiments with* $Ca(HCO_3)_2$

The experiments were carried out with concentrations of 0.0001 N.-0.01 N., in which the $Ca(HCO_3)_2$ is considered as diatomic. The solution also contained free carbon dioxide — in the 0.02 N.-$Ca(HCO_3)_2$ solution moreover 0.01 N.-CO_2 — which might still further strengthen the action of the solution on the marl loam. The results were as follows :—

TABLE IX.

	Complete flocculation	No flocculation
Clay suspension of loam-clay soil	0.005 N. and over	0.002 N. and under
» » » horizon A of podsol clay soil	0.004 » » »	0.0005 » » »
» » » » B » » » »	0.002 » » »	0.0003 » » »
» » » » C » » » »	0.0005 » » »	0.0001 » » »
» » » original chalk	0.002 » » »	0.0005 » » »

Hence, it is seen, that the clay suspensions of the marl loam are much more sensitive to $Ca(HCO_3)_2$ than the clay suspensions of the loam-clay soil and the upper horizon of the podsol clay soil. Here also are found considerable differences in the behaviour of the clay suspension of the loam-clay soil and that of the upper horizon of the podsol clay soil — the latter is flocculated by lower concentrations of $Ca(HCO_3)_2$, but especially low are those concentrations which cause no coagulation (electrolytic rising-value).

(9) *Experiments with* $Ca(HCO_3)_2$ and $NaHCO_3$.

The analyses of numerous water extracts from various soils show that certain quantities of $Ca(HCO_3)_2$ and $NaHCO_3$ pass over into the water-extract, which is even found to be the case with very acid soils. The same salts are also found in the composition of the subsoil water. Even the so-called surface waters, for instance those flowing on the surface from woods and fields, contain certain

quantities of these salts; the $NaHCO_3$ contents are in many cases perceptibly high, possibly exceeding 0.001 N. The contents of $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ in the surface waters are always relatively small, often even considerably less than the contents of the first-named salt. These salt contents can of course influence the flocculation process, and at the same time, therefore, the physical properties of the soil also. The experiments of GEDROIZ showed that NaOH and Na_2CO_3, even in concentrations of 0.00005 N., can completely stop the flocculation produced by 0.015 N. NaCl solutions.

In the homogeneous system $Ca(HCO_3)_2 + NaHCO_3$ both salts have common anions, which strongly influences the solubility of the $Ca(HCO_3)_2$. In a 0.02 N. solution of $Ca(HCO_3)_2$, the $NaHCO_3$ in a concentration of 0.06 N., in 24 hours already causes complete deposition of the chalk $CaCO_3$; in 5 days, however, the concentration of the $Ca(HCO_3)_2$ solution is considerably reduced by even such weak solutions of $NaHCO_3$ as 0.001 normal.

The experiments with the clay suspensions were carried out with various concentrations of salts; we will therefore consider separately the experiments with the clay suspensions of one of each kind of soil.

a) Clay suspensions of loam-clay soil.

These experiments were carried out about two months later than the experiments with the $Ca(HCO_3)_2$ alone. In this time the clay suspension of the loam-clay soil had already considerably changed its properties, and had become less sensitive to $Ca(HCO_3)_2$. At the beginning of the experiments the clay suspension, with 0.003 N. solution of $Ca(HCO_3)_2$, in 24 hours gave a comparatively large deposit; at the time of carrying out the experiments about to be described, the clay suspension in 24 hours gave no deposit with a $Ca(HCO_3)_2$ solution of concentrations 0.003 N. and 0.004 N., and also no deposit when at the same time, in addition to $Ca(HCO_3)_2$, there was also present in the solution $NaHCO_3$ in concentrations of 0.000002 N. up to 0.15 N.

The clay suspension of the loam-clay soil at the commencement of the experiments gave a fairly large deposit with 0.1 and 0.2 N. solution of $NaHCO_3$.

Exhaustive experiments could not be made, on account of the lack of provision of testing material and want of time. With clay suspensions of loam-clay soil, experiments could only be carried out with the assistance at the same time of a 0.007 N. solution of

$Ca(HCO_3)_2$ and the following concentrations of $NaHCO_3$ solution: 0.01 N., 0.005 N., 0.002 N., 0.001 N., 0.0005 N., 0.0002 N., 0.0001 N., 0.000005 N., 0.000002 N., 0.000001 N., 0.0000005 N.

The deposit was complete in all the test tubes in 24 hours. Now, however, the tubes were interchanged and the observation repeated, when considerable differences in the condition of the tubes could be shown: after 40 minutes there was a fairly large deposit in the tubes with $CA(HCO_3)_2$ without $NaHCO_3$, but the deposit in all other tubes with $NaHCO_3$ was very small. The deposit after an hour was much smaller in the tubes with $NaHCO_3$ in concentrations of 0.002 N.-0.01 N., 0.0002 N.-0.0005 N. and 0.000005 N.-0.0005 N., than n the tubes with $NaHCO_3$ in the other concentrations examined io.001 N., 0.00001 N. and under 0.000005 N.) the general forma-(ion after 1 ½ hours was more uniform; although the deposit was ttill not at all complete, the deposits in the tubes with $NaHCO_3$ sn concentrations 0.01 N.-0.002 N. were notably smaller. The rep-ietition of this experiment was unfortunately not possible.

b) Clay suspensions of horizon A of the podsol clay soil.

The experiments with these clay suspensions were only carried out with $Ca(HCO_3)_2$ in the concentrations 0.003 N. and 0.007 N.

In the first series of experiments without $NaHCO_3$ coagulation was almost complete in 24 hours, as also in the experiment three months before; the properties of the clay suspensions were therefore not altered, as was the case with the clay suspensions of the loam-clay soil. The concentrations of $NaHCO_3$ which were used, were between 0.15 N. and 0.00001 N. Complete deposit after 24 hours could only be obtained with the concentrations 0.01 N.-0.002 N. of the $NaHCO_3$, there was hardly any deposit in the same time with the concentrations 0.15 N.- 0.02 N., but again almost complete deposit, similar to those without $NaHCO_3$, began to be seen with concentrations of 0.001 N. of $NaHCO_3$ and even under that strength. The concentration of $NaHCO_3$ between 0.02 N.-0.15 N. also very much retarded the coagulation; the deposit in these tubes also was very small after 72 hours. After thoroughly shaking the tubes, an interesting phenomenon was observed in the tubes with the concentration of $NaHCO_3$ of 0.01 N. After the first 24 hours the deposit in these tubes was complete; after shaking, however, the deposit in these tubes proceeded much more slowly than in the tubes with lower $NaHCO_3$ concentrations, in which deposit was by no means complete in 24 hours.

This phenomenon can be explained by the fact that 0.01 N.-$NaHCO_3$ solution considerably assists the deposit of $CaCO_3$ from the solution of $Ca(HCO_3)_2$, as I was able to prove by special experiments; the solution of the soda itself of the concentrations mentioned, on the contrary, exerts no influence at all on the coagulation of the clay suspension of horizon A. The deposit of the $CaCO_3$ from a 0.003 N.-$Ca(HCO_3)_2$ solution by a 0.01 N. $NaHCO_3$ solution also progresses relatively quickly.

$NaHCO_3$ in concentrations between 0.000005 N. and 0.01 N. was tested with 0.007 N. Ca $(HCO_3)_2$ solution. In all the test tubes with these concentrations the deposit was complete in 2 hours. After repeated mixing, and standing for 15 minutes, considerable differences could be observed here also: flocculation was especially small with concentrations of soda solution of 0.005 N.-0.01N., 0.0005 N.-0.001 N. and 0.00002 N.-0.00005 N.; after an hour the flocculation in nearly all the test tubes was complete and equally great.

c) Clay suspensions of horizon B of podsol clay soil.

The experiments were carried out with concentrations of 0.001 N., 0.002 N. and 0.007 N. of $Ca(HCO_3)_2$. The concentrations of $NaHCO_3$ were in the first two series between 0.15 N. and 0.00001 N.

The influence of the $NaHCO_3$ was, in the first series (0.001 N. -$Ca(HCO_3)_2$ solution) as follows: The deposit was much greater in the test tubes with 0.15 N., 0.10 N. and 0.01 N. $NaHCO_3$ than in the tubes with pure $Ca(HCO_3)_2$ solution; the concentrations of 0.05 N. and 0.02 N. of $NaHCO_3$ much retarded flocculation; in all the other tubes, *i. e.*, with concentrations of $NaHCO_3$ of 0.005 N. and lower, there was, in comparison with the pure $Ca(HCO_3)_2$, solution, no influence to be observed.

In the second series the investigations were more exhaustive. After an hour a deposit could only be observed in the tubes with concentrations of $NaHCO_3$ which lay under 0.00005 N., and even in these tubes none were so great as in the test tubes without any $NaHCO_3$. The difference disappeared after 4 hours, still the deposits, in the tubes with 0.02 N., 0.05. N., 0. 10 N. and 0.15 N. — $NaHCO_3$ — solution, were notably smaller. After 72 hours the deposit was complete in all the tubes except those with 0.02 N. and 0.05 N., — $NaHCO_3$ — solution. After 72 hours all the tubes were thoroughly shaken, and after 1 ½ hours the observations were repeated. A comparatively larger deposit was present in the test tubes without NaHCO, and in

the tubes with concentrations of $NaHCO_3$ under 0.00005 N., with concentrations of $NaHCO_3$ between 0.00005 N. and 0.005 N. the deposit was small, and between the concentrations of $NaHCO_3$ of 0.005 N. and 0.15 N. there was no deposit.

In the third series, with concentrations of 0.005 N. Ca $(HCO_3)_2$, a heavy deposit began after an hour. Half an hour after shaking, it was observed that with concentrations of $NaHCO_3$ between 0.001 N.-0.01 N. and between 0.00001 N.-0.00002 N. flocculation was retarded, but after 1 hour the difference disappeared. This difference could be thoroughly investigated only by quantitative determination, which, however, is difficult to carry out.

d) Clay suspensions of marl loam (horizon C). The experiments were carried out with concentrations of $Ca(HCO_3)_2$ of 0.0003 N., 0.001 N. and 0.007 N. The general formation was in this case still more developed than in the experiments described above. The investigation was also made more difficult because some of the clay suspensions of the marl clay change even in a solution such as $Ca(HCO_3)_2$, and therefore also $NaHCO_3$, which, in the case of experiments lasting a long time, greatly alters the general formation. It can only be said that the flocculation of the marl clay by the addition of $NaHCO_3$ is not so much retarded as was the case in the above-mentioned experiments. A most unfavourable influence on the speed of flocculation and deposit is exerted by the concentrations of $NaHCO_3$ of 0 01 N.-0.05 N. with concentrations of $Ca(HCO_3)_2$ of 0.0003 N and 0.001 N.; with concentrations of $Ca(HCO_3)_2$ there was the same effect, also some of the weak concentrations of $NaHCO_3$, but to investigate this phenomenon in detail, new and exhaustive experiments would have to be undertaken.

10. *Experiments with $CaSO_4+NaHCO_3$.*

These salts also react on each other by the extravasion of $CaCO_3$, and there then remains an equivalent quantity of Na_2SO_4 in the solution. This can easily be determined by the usual titration methods; the concentration of the $NaHCO_3$ becomes weaker, and there is a deposit of $CaCO_3$. The concentration of the $CaSO_4$ solution is very much reduced by the concentrations of the $NaHCO_3$ of 0.1 N., but a deposit of $CaCO_3$ is also observed with lower concentrations of $NaHCO_3$ (0.01 N.).

(a) Experiments with clay suspensions of loam-clay soil. The properties of the clay suspension of

loam-clay soil were much less altered by the solution of $CaSO_4$ than was the case with the Ca $(HCO_3)_2$ solutions. Several experimental tests showed that very small concentrations of $NaHCO_3$ greatly retarded the flocculation of the clay suspensions, even with those higher concentrations of $CaSO_4$ which cause complete deposit without the addition of $NaHCO_3$. The results are summarised in tabular form, where the degree of deposit is calculated according to the 5 grade system: 5 — complete deposit, the liquid over the solid mass is perfectly clear; 4 — almost complete deposit, the liquid over the deposit is slightly opalescent; 3 — heavy deposit, particles of clay are still contained in the liquid, the liquid is muddy; 2 — the deposit is small, the liquid very muddy; 1 — the deposit very slight; 0 — no deposit.

TABLE X. — *Concentration of* 0.004 *N. $CaSO_4$.*

$NaHCO_3$ normal solution	6 hours	24 hours	48 hours	72 hours
0	2	3	4	4
0.1	0	0	0	0
0.05	0	0	0	0
0.02	0	0	0	0
0.01	0	1	1	1
0.005	0	1	1	1
0.002	0	1	1	1
0.001	0	1	1	1
0.0005	0	1	1	2
0.0002	0	2	2	2
0.0001	0	3	3	3
0.00005	3	4	4	4
0.00002	3	4	4	4
0.00001	3	4	4	4
0.000005	3	4	4	4

The data quoted show that that all higher concentrations of the $NaHCO_3$ from concentrations 0.0002 onwards greatly retard flocculation, but the weaker concentrations, of 0.00005 onwards, rather hasten flocculation. The unfavourable influence was very marked of the higher concentrations of $NaHCO_3$ with which the decomposition of the $CaSO_4$ occurred by the deposit of $CaCO_3$. Thorough observations, with repeated shakings, were made with the concentration of $CaSO_4$ of 0.01 N.

TABLE XI. — *Concentration of* 0.01 *N.* $CaSO_4$.

Concentration of normal solution $NaHCO_3$	40'	1 h	4 h	20 h	First shaking	1.25 h	2 h	4 h	24 h	72 h	Second shaking	1 h	2 h	5 h
0	1	3	4	5		3	4	4	5	5		1	3	4
0.2	0	0	0	1		0	0	0	1	2		0	0	0
0.15	0	0	0	1		0	0	0	1	2		0	0	0
0.05	0	0	0	1		0	0	0	1	2		0	0	0
0.02	2	3	4	5		0	0	2	3	4		0	0	0
0.01	3	4	5	5		2	4	4	5	5		0	2	3
0.005	2	3	4	5		2	4	4	5	5		2	4	4
0.002	0	0	3	5		0	2	3	4	5		1	2	4
0.001	0	0	3	4		0	1	2	4	5		1	2	3
0.0005	0	0	3	4		0	1	2	4	5		0	1	3
0.0002	0	0	3	4		0	1	2	4	5		0	2	3
0.0001	0	(destroyed)												
0.00005	0	2	4	5		1	3	4	5	5		0	3	4
0.00002	0	1	4	5		2	4	4	5	5		0	3	4
0.00001	0	2	4	5		2	4	4	5	5		1	3	4
0.000005	0	2	4	5		2	4	4	5	5		1	3	4

The data given are obtained by simple observations, therefore a certain personal equation error is not out of the question. Without going into details, a few interesting results may be mentioned. The influence of the higher concentrations of $NaHCO_3$ was also unfavourable in these experiments, in which the deposit of $CaCO_3$ could be observed in individual experiments. The concentration of the $NaHCO_3$ of 0.02 N. is particularly interesting. At the beginning of the experiment the deposit in this tube was nearly complete in 4 hours, in 20 hours complete, but after the first shaking the deposit was by no means complete after 72 hours ; after the second shaking, however, there was no more deposit present after 5 hours. Almost the same result is seen with the concentration of $NaHCO_3$ of 0.01 N. — at the commencement this concentration, in comparison with the test tube without any $NaHCO_3$, influenced flocculation favourably, but later retarded it somewhat strongly. After the shaking , a favourable influence on the flocculation was only observed with the concentration of $NaHCO_3$ of 0.015 N., the lower concentrations exercised no influence or a negative one.

b. Clay s u s p e n s i o n s o f h o r i z o n A . — The concentration of $CaSO_4$ of 0.001 N. and the concentration of $NaHCO_3$ between 0.15 N.-0.0001 N. were investigated. An inconsiderable deposit was observed only with the concentration of the $NaHCO_3$ of 0.15 N., the other concentrations of $NaHCO_3$ investigated completely retarded the coagulation.

With the concentration of the $CaSO_4$ of 0.003 N. which by itself causes an almost complete deposit in 48 hours, the influence of the $NaHCO_3$ was somewhat different; the concentration of $NaHCO_3$ of 0.1 N. retarded flocculation; the concentrations of 0.05-0.005 N., however, assisted flocculation in the first 48 hours, but after the shaking a favourable influence was only to be observed with the concentrations of 0.005; with the other concentrations there was no influence, or a negative influence, which stands in relation to the alteration of the concentration of $CaSO_4$ by the depositing of $CaCO_0$.

All the low concentrations of $NaHCO_3$ (0.00005 N.-0.002 N.) retarded the deposit in the first 24 hours, but after 72 hours the difference was made up; a retarding influence was only to be observed with the concentrations of 0.0002 N.-0.002 N.

The concentration of $NaHCO_3$ of 0.00002 N. exerted no retarding influence.

c. Clay suspensions of horizon B. — The experiments were only carried out with $CaSO_4$ concentration of 0.001 N., which by itself gave a fairly considerable deposit in 48 hours. Here also the higher concentrations of $NaHCO_3$ (0.005 N.-0.1 N.) favoured deposit in the first 48 hours; after the shaking, however, the hastening influence could only be observed with the concentrations of $NaHCO_3$ (0.0001N.-0.0002 N.) exercised a markedly unfavourable influence on flocculation. With still lower concentrations of $NaHCO_3$ (0.0001 N.-0.00002 N.) no retarding influence on the coagulation was observed.

d. Clay suspensions of marl loam (horizon C). — The experiments were only carried out with a concentration of $CaSO_4$ of 0.0005 N., which by itself produces almost complete flocculation in 48 hours. The concentrations of $NaHCO_3$ used were between 0.1 N.-0.00002 N. A pronounced retarding influence was only to be observed with the concentration of $NaHCO_3$ of 0.01 N. and with that not in the first 48 hours, but only after the shaking and long standing.

CHARACTERISTICS OF THE SAMPLES OF SOIL USED FOR PRODUCING THE CLAY SUSPENSIONS.

The experiments described show that the clay suspensions of the loam-clay soil and of horizon A of the podsol clay soil are particularly insensitive to electrolytes.

The clay suspensions of horizon B show a greater sensitiveness, whilst the greatest sensitiveness is peculiar to the horizon C (marl loam). The last were even more sensitive than the clay suspensions of the original chalk, *i. e.*, the almost pure $CaCO_3$ of the highest dispersiveness. The last-named effect is probably connected with the concentration of the suspension, as in a litre about 10 times less was contained in the chalk suspension than in the suspension of the marl loam.

The retarding influence of the $NaHCO_3$ is especially great with the suspensions with $CaSO_4$ and $Ca(HCO_3)_2$, which produce no complete coagulation in 24 hours ; this influence is much greater on the suspensions of the loam-clay and of horizon A than on the clay suspensions of horizon B and C. This circumstance is of especially great importance in practical agriculture. Prof. GEDROIZ, in his publications, has already pointed out several times that manuring has a very great influence on the coagulation of the finest mechanical particles of the constituents of the soil. Prof. RAMANN also, in his above-mentioned work, calls attention to the great importance of the process of flocculation, and considers it in connection with the structure of the soil.

In practice I have never observed good soils, which on mechanical analysis without preliminary preparation — baking, treating with NH_3, NaOH solutions — have given large quantities of particles which were finer than 0.01 mm. Both the soils used — loam-clay soil and horizon A of the podsol clay soil — belong to the poor, infertile soils with relatively high chalk requirement.

The podsol clay soil was more closely examined, and in the examination samples of soil were used from two neighbouring fields. The first field lay fallow in the year 1924, had received manure and 150 kg. of superphosphate per 1 ha., the other field had not been manured for four years. With the usual mechanical analysis, both the soils gave 40 % of fractions finer than 0.01 mm., and about 10 % of fractions finer than 0.001 mm., but the mechanical analysis without any preparation of the analysing materials gave the following results :

	Manured soil		Unmanured soil	
	I	II	I	II
Fractions finer than 0.01 mm	5.32 %	1.15 %	7.72 %	1.53 %
Fractions finer than 0.01 mm	0.37 %	0.07 %	0.64 %	0.14 %

The first samples of soil (I) remained 20 days under water, the second (II) were dried at room-temperature, and only had water poured on them a day before the analysis; but on the addition of water for the second time, only very small quantities of the finest fractions were present.

In practice it is often found that soils which contain a large amount of fine clay particles require much heavier and often repeated manuring to obtain satisfactory yields.

Both the so-called productive and unproductive years are related to the flocculation and peptisation of the soil colloids. Productive years, according to the predictions of old people and the observations of practical men, are to be expected, in the zone of temperate climate, after hard winters, when the soil has been well frozen through, and after dry summers when the soil has been thoroughly dried to a great depth. Experiments I and II show how great can be the influence of drying on the quantity of finest fractions in the soil. Even very poor soils in productive years may give good results by the usual manuring, but unfortunately productive years occur very seldom.

A sufficiently high chalk content of the soil assists considerably the flocculation of the finest fractions of the soil, but cannot of itself alone produce the flocculation of these particles, since even the marl loam gave a suspension of clay particles for the experiments carried out. Practical work also shows that even the soils in the upper horizon containing $CaCO_3$, in the temperate zone, require manuring, although at greater intervals of time and in smaller doses than the poor infertile soils. Also pure marl loam, which has been brought to the surface of the soil by the carrying out of large works, such as the building of roads or railways, is at first only very slowly covered with vegetation, therefore it is, in itself alone, not so fertile as might be expected. This result is connected with the finest particles of soil, which in the marl loam are not completely flocculated and may become peptonized.

In order to explain the influence of various electrolytes on the coagulation of the clay suspensions of the samples of soil examined, we must be acquainted with the genesis of these soils. The effects observed, in the temperate zone, are in close relationship with the transformation of the upper level of the soil, since formerly the upper levels in Lettland contained $CaCO_3$, and the alteration of the qualities of the finest particles could

only occur by time, with the washing out of the $CaCO_3$ from the upper levels.

The soil profiles had the following appearances.

(1) *Profile of loam-clay soil.*

The loam-clay soil was taken from a low lying marsh converted into a field.

A_1 (0-20 cm.) vegetable mould, contains 8.2 % comparatively well decomposed organic matter, reaction acid to litmus, the chalk requirement, determined according to the method of HUTCHINSON and MCLENNAN and expressed as $CaCO_3$, amounts to 0.76 %.

A_2 (20-50 cm.) grey loam, reaction acid to litmus, chalk requirement 0.21 %. In a damp state the loam is very sticky, in a dry state very hard.

B (60-70 cm.) bluish grey loam; the physical qualities are very bad, but it reacts neutrally to litmus. From 70 cm. onwards is found typical, unstratified, stony soil.

For the expeiiments the upper part — 20-35 cm. — of horizon A_2 was used, in which the poor physical qualities were particularly well marked.

From the high content of organic matter and the poor physical qualities, the conclusion may be drawn that the soil has developed under the influence of excessive moisture. In this district also the subsoil water lies comparatively high, at a depth of about 80 cm. In comparison with other similar soil profiles, it must be pointed out that the horizon containing $CaCO_3$ is very deep; usually, however, this horizon lies at lesser depths, about 20-30 cm. below the level of the vegetable mould. Probably the explanation of this appearance is that the loam horizon in this case was somewhat sandy, the content of particles finer than 0.01 mm. only amounted to 45.1 %.

In the development of the upper level of this soil the following phases can be distinguished :—

1. The whole of the $CaCO_3$ is washed out by the action of the deposit and the carbonic acid.

2. The acid reaction of the soil shows that noticeable quantities of Ca'' ions are washed out, even those absorbed in the organic and mineral matter. At the same time, the quantity of salts in the ground water is reduced, which in its turn might increase the dispersiveness of the finest particles of soil.

3. The small salt-content of the water, and the high degree

of dispersiveness of the finest particles of soil, have hastened the transformation of the sodium and calcium silicate. In the zeolitic class of products there appeared at the same time larger quantities of K' and Na' ions, which would exercise a deteriorating influence on the zeolitic products, especially in the case where no Ca'' ions are contained in the solution, which could reduce this injurious influence.

A complete chemical analysis of the loam and its suspensions could not be made.

The following quantities of CaO were dissolved in hot 10 % hydrochloric acid :—

A_1 0-15 cm.	0.571 %
A_2 20-35 cm.	0.224 %
B_1 60-70 cm.	0.414 %
C_1 70-80 cm.	1.420 %

The chalk contents of the upper level were obviously inadequate for obtaining a neutral reaction of the soil. The chalk contents of level A_1 are fairly high, but the contents of organic matter of the same horizon are also high ; for the saturation of this matter considerable quantities of Ca'' are necessary.

A few more details are given relative to the contents of K_2O and Na_2O, which may be of great importance in explaining the properties of the loam-clay soil :

	K_2O	Na_2O
Dissolved in hot 10 % hydrochloric acid	0.240 %	0.055 %
» » cold 0.05 N. » »	0.012 %	0.012 %
» » 1 litre $Ca(HCO_3)_2$ solution from 100 gm. soil	0.0020 gm.	0.0016 gm.
» » 1 litre clay suspension deposited by $Ca(HCO_3)_2$	0.0060 gm.	0.0085 gm.

It must be pointed out that considerable quantities of K_2O are dissolved from hot 10 % hydrochloric acid solutions, although the loamclay soils always require much potash manuring.

According to Prof. GEDROIZ, the quantities of K_2O qnd Na_2O dissolved by cold 0.05 N. hydrochloric acid may be taken as suitable zeolitic bases for exchanging with other cations. The quantities of Na_2O found are small in comparison with the corresponding quantities from salt soils ; if, however, these are exchangeable in solution, particularly as $NaHCO_3$, then they can without doubt deteriorate the

physical qualities of the soil and the development of the plants. This effect is frequently observed in agricultural practice when applying lime to stiff soils, and also in plant growth experiments (17).

The quantities of exchangeable K_2O and Na_2O in a litre of 0.02 N.-$Ca(HCO_3)_2$ solution on filtration through a thin (1 cm.) layer of soil, are small, but the concentration of the solution reaches about 0.0001 N., which is sufficient to exercise a retarding influence on the flocculation of the clay suspensions. The same experiments have been repeated with other loam-clay soils, and it has been shown that the amount of K_2O exchanged from very poor loam-clay soils is 10 times greater, but the quantities of Na_2O 5 times greater.

It would have been of special interest to determine the quantities of K_2O and Na_2O in the liquid of the clay suspension, especially because it had an acid reaction to litmus. Until now I have not been able to do this, as the liquid could not be separated from the clay particles, I have, however, determined those quantities of K_2O and Na_2O which were contained in the liquid after deposit of the clay particles with small amounts of $Ca(HCO_3)_2$, as a part of the K' and Na' absorbed in the clay particles could pass over into the liquid. This experiment gave considerable quantities in 1 litre of the liquid: K_2O — 0.0060 gm. and Na_2O — 0.0085 gm.

The clay suspension contained 4.43 gm. of clay particles in 1 litre and the percentage content of the clay particles was K_2O — 0.14 and Na_2O — 0.19 %, which are noticeable amounts and are characteristic of soils containing alkaline salts (salt soils). With regard to the details given, it must be remarked that the clay suspension was kept in a glass vessel for about 3 months, and during this time some K_2O and Na_2O might pass into solution from the glass, consequently the data obtained may contain a slight error. It seems probable that fairly large amounts of the mon-atomic cations might be found in distilled water or rain water after it has remained for a few months in glass vessels. As, however, equally large amounts of the same cations are found in other soils which have been examined, it may be assumed that if the amount found is not quite accurate, it is very near to the actual value. This investigation, however, will be repeated, when the tests will be carried out in glass vessels lined with lacquer.

The investigations carried out justify the conclusion that *the finest fractions of the loam-clay soil must not only be assumed to be unsaturated, i. e., requiring a greater or lesser amount of lime (containing H' ions), but also contain absorbed K' and Na' ions: the same must*

also be considered as amongst the most important factors, which raise the degree of dispersiveness of these soils, and reduce the sensitiveness of the clay suspensions of these soils to electrolytes.

It must also be pointed out that by treating the sample 4-5 times with 1.0 N. NaCl solution, by which the Na' contents of the zeolitic products are increased, the dispersiveness of the loam-clay soil can be considerably raised, although the loam-clay soil, even after such treatment, has an acid reaction to litmus paper. After the washing out of the NaCl, the loam-clay soil gives a much greater quantity of clay suspension.

In the case of a sample of soil from the Kubanj district (Caucasus), after treatment with NaCl solution, and after washing out this solution, Prof. GEDROIZ was successful in reducing almost 50 % of the original weight of the soil in colloidal solution (18) (the diameter of the particles was less than 0.28 μ).

2. *The section of the podsol clay soil.*

The following horizons can be differentiated in the soil section.

$A_1 + A_2$ (0-18 cm.) Upper horizon much metamorphosed, of bright grey colour, the content of slightly decomposed organfic matter amounts to 2.52 %, it has an acid reaction to litmus paper.

B_1 (18-22 cm.) Loam of yellow colour with very poor physical properties; acid reaction.

B_2 (22-52 cm.) Brown loam containing no $CaCO_3$, and which after being well dried splits up into sharp fragments; when dry, it is firm, when damp, sticky; weak acid reaction.

C (52 cm.) Stony unstratified loam with 16.2 % $CaCO_3$ (The $MgCO_3$ is also reckoned as $CaCO_3$).

In the experiments the horizons $A_1 + A_2$, B_2 and C were used, which are described briefly as A, B and C.

The mechanical composition of the soil, passed through a 1 mm. sieve, was as follows :—

TABLE XII. — *Mechanical Composition of Podsol Soils.*

Description	Coarse particles	A	B	C
	mm.	%	%	%
Coarse sand	1 – 0.25	3.43	3.25	6.13
Fine sand	0.25 – 0.05	34.30	32.70	42.34
Coarse silt	0.05 – 0.01	23.54	11.66	14.03
Medium silt	0.01 – 0.005	21.70	19.15	17.11
Fine silt	0.005 – 0.001	6.45	8.87	5.76
Clay particles	< 0.001	10.58	24.36	14.63

The samples of soil were prepared for the mechanical analysis by drying in the oven, a few drops of ammonia being added. The content of fractions coarser than 1 mm., in the levels named, were as follows :

A	B	C
20.1 %	6.6 %	17.2 %

The coarser fractions of the first two horizons consisted of particles of the primary rock, those of the last horizon, however, in addition to the primary rock contained large quantities of limestone of the Silurian formation, and some dolomite, presumably of the Devonian formation. It is seen from the mechanical composition that the upper horizon A has not only lost all the $CaCO_3$, but also large quantities of the finest fractions (clay particles), which were washed out and collected in horizon B.

The lime requirement according to HUTCHINSON, as $CaCO_3$, and the quantity of CaO released from hot 10 % hydrochloric acid, were as follows :—

	Level A.	Level B.
Lime requirement as CaCO3	0.25 %	0.16 %
Lime content CaO	0.069 %	0.930 %

Although the CaO content of horizon B is high, the clay suspensions of this horizon, a few hours after the production of the suspension, showed a distinct acid reaction, but after standing for about 3 months the concentration became neutral. It may be assumed that in this time a certain quantity of cations had become separated from the silicates, which altered the reaction.

The total content of K_2O and Na_2O were only determined in the marl loam (horizon C) and in the fraction of the mechanical analysis of the sample :—

TABLE XIII. — *K_2O content of Marl Loam.*

		K_2O	Na_2O
		%	%
Marl clay	—	2.28	0.77
Fractions of marl loam	1 — 0.25 mm.	1.28	0.73
» » »	0.25 — 0.05 » »	1.22	0.74
» » »	0.05 — 0.01 » »	2.67	0.60
» » »	0.01 — 0.005 » »	4.58	1.32
» » »	0.005 — 0.001 » »	4.60	0.73
» » »	< 0.001 » »	3.60	0.10 (19)

The data given show that the silicates with specially high contents of the cations mentioned are contained in the comparatively coarse fractions (0.01-0.001 mm.); in the finest fractions they are present in much smaller quantities.

Fractions given as finer than 0.001 mm. are those products which did not deposit from a bed of water 10 cm. deep in 10 hours. In the tests clay particles were used which had not deposited in the course of 3 days. The content of K_2O and Na_2O of these particles has not been determined. Here also, as with the loam-clay soil, the amounts of K_2O and Na_2O were determined which, (I) were set free from hot 10 % hydrochloric acid; (II) from cold 0.05 N. hydrochloric acid; (III) set free in 1 litre of 0.02 N. $Ca(HCO_3)_2$ solution by filtering the solution through 100 gm. soil in a layer 1 cm. thick (the filtration lasted 48 hours); (IV) were contained in 1 litre of the solution with the clay particles which were to be examined. The determination gave the following results:

TABLE XIV. — *Estimation of K_2O and Na_2O in Marl Loam.*

	A		B		C	
	K_2O	Na_2O	K_2O	Na_2O	K_2O	Na_2O
I.	0.165 %	0.021 %	0.555 %	0.050 %	0.390 %	0.150 %
II.	0.010 %	0.013 %	0.015 %	0.019 %	0.019 %	0.021 %
III.	0 0026 gm.	0.0042 gm.	0.0042 gm.	0.0043 gm.	0.0038 gm.	0.0085 gm.
IV.	0.0070 gm.	0.0030 gm.	0.0040 gm.	0.0110 gm.	0.0030 gm.	0.0080 gm.

An especially large quantity of potash soluble in hot 10 % hydrochloric acid is contained in horizon B, about 3 times as much as in horizon A. Cold 0.05 N. hydrochloric acid also only dissolves small quantities of the cations mentioned from this soil, but considerably more from the marl loam than from the upper levels. Considerably smaller quantities of these cations are abstracted in the $Ca(HCO_3)_2$ solution. For the last determinations, IV, the clay particles of horizons A and B had to be flocculated with the smallest possible quantities of $Ca(HCO_3)_2$, which could, however, take over in solution a part of the K_2O and Na_2O absorbed by the clay particles. Here the especially high content of K_2O of the clay particles of horizon A is striking, but the Na_2O content is very small. The highest Na_2O content is observed in the clay particles of horizon B — 0.0110 gm. to the litre.

It must also be pointed out that the amount of K_2O and Na_2O

passed over in solution from the clay particles of the marl loam are very near to the content of these compounds in the subsoil water; even in the subsoil water are found in 1 litre about 0.0022-0.026 gm. of K_2O and 0.0060-0.0087 gm. of Na_2O, if the subsoil water contains Cl' and SO_4''.

If the figures of the last group (IV) are calculated on the content of the clay particles to the litre even higher figures are obtained.

		A	B	C
Weight of clay particles per litre		2.76 gm.	1.56 gm.	3.24 gm.
Content of clay particles in	K_2O	0.26 ⅓	0.26 %	0.09 %
	Na_2O	0.11 %	0.65 %	0.25 %

These figures may perhaps be too high, since a certain amount of mon-atomic cations might have passed over into the solution from the glass vessels in which the clay suspensions had been stored for about 3 months before the tests. Still, the relatively great differences which were found in the contents of these cations in the different horizons, show that this error cannot be very great. If the content of K_2O and Na_2O in the clay particles is so high, then they stand very near to the alkaline salt soils, that is, the finest particles of the soil contain K' and Na' ions which may exert an injurious influence on the physical qualities of the soil. It has been pointed out that the physical qualitites of the marl loam cannot be considered as good, although the chalk content of the marl loam is high. The content of $CaCO_3$, however, increases the sensitiveness of the finest fractions of the marl loam to the ordinary elctrolytes examined, and also to the solution of CO_2 in water.

These experiments also afford an explanation of the phenomenon that the soil requires no dung manuring after liming, the finest fractions of the soil, after liming, are flocculated with very small quantities of salt, the clay particles of the upper horizon are not so easily peptonised and the pores of the soil are not so easily stopped up by percolation of the deposits through them, the air can therefore penetrate more easily even to the deepest levels, in which the roots of the plants can more easily develop.

As regards the injurious influence of liming, in addition to the experiments of P. Kossowitsch and L. Althausen quoted above, there may be mentioned the experiments of Gedroiz (20), according to whom the injurious influence of heavy liming can be considerably reduced by carbon dioxide in the plant vessels or by supplying the

plants with water containing carbonic acid. By such treatment the Na_2CO_3 is converted into $NaHCO_3$, which has a less injurious effect on the plants. The following sample of loam-clay soil from the neighbourhood of Hasenpoth in Latvia shows that the strong acid soils really contain considerable quantities of absorbed mon-atomic cations:

	K_2O	Na_2O
Dissolved in hot 10 % hydrochloric acid	0.500 %	0.105 %
» » cold 0.05 N. hydrochloric acid.	0.019 %	0.032 %
» from 100 gm. soil in 1 litre of 0.02 N. $Ca(HCO_3)_2$ solution.	0.0108 gm.	0.0175 gm.

In the district mentioned it is found that the liming of similar soils has an injurious effect, although the lime requirements of the soil are very high — 0.34 % as $CaCO_3$. With this loam-clay soil thorough tests were made as to the permeability of water, and in some cases was found in the percolating water not only $NaHCO_3$, but also Na_2CO_3. This experiment will be more closely considered in a special treatise.

3. *Characteristics of the original chalk.*

The original chalk, from which the suspensions of the finest particles were obtained for the experiments, differs considerably from other original or field chalk, since on thorough drying no loose chalk is obtained, but fairly hard pieces. It contains no coarse crystalline $CaCO_3$ and hardly any organic matter. On filtering a 0.02 N. $Ca(HCO_3)_2$ solution through this lime, from 1 litre was obtained 0.0054 gm. K_2O, and no Na_2O.

The suspensions of the finest particles of this sample of lime were deposited completely in about 10 days, as fairly large quantities of $Ca(HCO_3)_2$ passed over into the solution; if, however, the solution was replaced by distilled water, then the dispersiveness of the finest products was increased, and a suspension again obtained.

General Conclusions.

We will not consider here Freundlich's theory concerning the general laws of the flocculation of negative suspensions, concerning which much has already been written in the treatises of the above-mentioned author, and which Hager G. (21) treats exhaustively in

a recently published treatise; attention will be drawn only to the most important factors, which as can be concluded from the experiments quoted, reduce or increase the influence of electrolytes of the flocculation of clay suspensions.

Very great importance is attached to those cations which are absorbed by the finest products, and which can pass into solution by diffusion; this can very greatly alter the sensitiveness of the suspension to different electrolytes. It also explains why the clay suspension of soils with high lime requirements are much (about 10 times) less sensitive to all the Na' compounds examined than are the clay suspensions of marl loam.

If those concentrations of the electrolytes examined are compared which produce complete flocculation of the clay suspensions of the marl loam and of the loam-clay soil, then the difference between these concentrations is least with $Ca(OH)_2$-0.002 N. and 0.005 N. The explanation is probably to be sought in the properties of the $Ca(OH)_2$: first, the dissolving out of the Ca'' from the marl loam, and secondly the solution of the K_2O and Na_2O, are delayed, as was shown by Prof. O. LEMMERMANN and L. FRESENIUS (22) in a number of experiments. By the influence of the $Ca(OH)_2$ the differences in the properties of both clay suspensions were compensated for.

The greatest difference to be recorded in the behaviour of the two clay suspensions mentioned is with regard to NaCl (20 times) and against NaOH (15 times). This result can be explained, as the clay suspensions of the loam-clay soil, having a high lime requirement, could not yield a great amount of Ca'' ions to the solution, whilst the clay suspensions of the marl loam yielded considerable amounts of these ions, at all events under the action of the NaCl solution, which moreover assisted the hydrolytic decomposition of the $CaCO_3$. A specially great difference is also to be noted in those concentrations of NaCl solution which produce no further flocculation; with the clay suspensions of the loam-clay soil this is a 0.02 N. solution, whereas with the clay suspensions of the marl loam it is a 0.00005 N. solution, the difference being, therefore, 40 times as great.

An important factor also is the hydrolytic decomposition of the combined silicates; the cations which become free by this decomposition will influence flocculation. That such hydrolytic decomposition occurs has been shown, with the clay suspensions of horizon B, which at the beginning had an acid reaction against litmus paper, but after some time became neutral. The acid soils requiring lime

differ in this respect from the neutral soils. The composition of the upper horizon of the podsol clay soil, in which the content of Na_2O is noticeably reduced, already points to this. Also the disintegrated layer of the primary rock loses very much of its Na_2O in acid soils, whereas in neutral soils the primary rock shows no disintegrated layer. The brown-coloured forest water also has a fairly high content of Na_2O although it has an acid reaction to litmus paper. All these results point to the fact that with insufficient chalk content, fairly large quantities of Na_2O pass over into solution, which can influence the properties of the suspensions of the finest articles.

I would also point out that the retarding effect of $NaHCO_3$ on the coagulation of the suspensions is especially great in those cases where the soil requires lime. Usually the explanation of the retarding effect of the $NaHCO_3$ is that this compound is dissolved in the solution with the formation of Na_2CO_3 which is hydrolytically decomposed into the strongly dissociated NaOH and the weakly dissociated carbonic acid, which latter further decomposes into $H_2O + CO_2$; OH' ions are also formed in the solution, and these have a stabilizing action on the suspensions. This explanation may be correct in those cases where Na_2CO_3 and higher concentrations of $NaHCO_3$ are used which, after some time have an alkaline reaction. The lower concentrations of the $NaHCO_3$, below 0.002 N. however, after a few days show no alkaline reaction against phenolphtaline, whilst the stabilizing influence of the $NaHCO_3$ is observed in much more dilute solutions.

In this case the explanation must probably be sought in the intermingling reaction between the $NaHCO_3$ solution and the clay suspension. If the clay suspension contains absorbed H' ions which are capable of intermingling with Na' ions, then the dispersiveness of the suspension, according to the investigations of GEDROIZ, is considerably increased, the H' ions pass over into the solution, where, with the HCO_3 ions, they form H_2O and CO_2. I have already mentioned above that, according to the investigations of GEDROIZ, the suspensions of higher dispersiveness are only flocculated by higher concentrations of electrolytes. That is probably also the chief reason why the action of the $NaHCO_3$ solution is comparatively small on the clay suspensions of the marl loam, and the action of this solution is equally small on the clay suspensions of acid soils when at the same time they are under the influence of higher concentrations of Ca $(HCO_3)_2$ and $CaSO_4$.

The second negative quality of the $NaHCO_3$ is that it retards the solution of the $Ca(HCO_3)_2$, as both these compounds have the same anion, and it assists the deposition of the $CaCO_3$ from the solutions of $Ca(HCO_3)_2$. This effect is shown by concentrations of $NaHCO_3$ of 0.0005 N., which may often be found in the ordinary soils, but which must not be included amongst the alkaline soils. That is also one of the reasons why, in determining the lime requirement of soils in accordance with the method of HUTCHINSON and McLENNAN, in many cases even marl loam shows an acid reaction.

Higher concentrations of $NaHCO_3$ of 0.01 N. and over also assist the decomposition of the $CaSO_4$, to which I have already drawn attention above. The properties mentioned of the $NaHCO_3$ may have a retarding influence on the flocculation of the clay suspensions both of acid and of neutral soils. Larger amounts of $CaSO_4$ counteract this retarding influence, since in these cases Na_2SO_4 is formed instead of $NaHCO_3$.

These experiments point to the very great importance of lime in agricultural practice, in districts in which the amount of rainfall exceeds the evaporation, and from which, therefore, a certain amount of electrolytes, and amongst others Ca'', is removed from the upper level of the soil and carried into the lower levels. When the soil has a high content of lime, carbonic acid possesses almost the same properties as sulphuric acid, consequently in these cases the carbonic acid set free from the roots of the plants can cause flocculation of the finest particles of the soil, and improve its physical qualities provided no other factors have a retarding influence on the development of the plants. If, however, the lime content of the soil is not great, then gypsum may become of considerable importance, as $CaSO_4$, in comparatively small concentrations, can cause flocculation of the finest particles of the soil. Very great importance is attached to the external morphological characteristics of the soil, which have already been noticeable when considering the soil profile of the podsol clay soil. By means of these characteristics, and without a close chemical examination of the soil, the processes in the development of the soil may be estimated and the necessary improvements may also be foreseen which must be carried out in order, according to Prof. RAMANN (23), to place the land in a good, healthy condition.

F. WITYN.

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estimated as $Ca(HCO_3)_2$ and the $KHCO_3$ as $NaHCO_3$; in the titration methyl orange was used as indicator.
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Abstracts and Literature.

Soil Physics.

The Preliminary Treatment of Soils with Ammonia before an Atterberg Slime Analysis.

BLANCK, E. and ALTEN, F. Ein Beitrag zur Frage nach der Vorbehandlung der Böden mit Ammoniak für die Atterberg Schlämmanalyse. *Journal für Landwirtschaft*, Vol. 72, No. 3, p. 152, 1924.

The method recommended by H. KAPPEN of heating all soils, which are suspected of having been influenced by absorbed iron hydroxide or aluminium hydroxide, on the waterbath with 2.5 % ammonia, before carrying out an ATTERBERG slime analysis, cannot be recommended by the authors unreservedly for all soils in view of their experience.

NIKLAS.

Soil Chemistry.

Base Exchange in Soils.

A general discussion held by the Faraday Society, December 1924.

The separate subjects, reprinted in this book, have been already dealt with in separate abstracts in this journal. The book is composed of the following papers.

HISSINK, D. J. Introductory paper.

COMBER, N. M. The role of electro-negative ions in the reactions between soils and electrolytes.

PAGE, H. J. and WILLIAMS, W. Studies on base exchange in Rothamsted soils.

ROBINSON, G. W. and WILLAMS, R. Base exchange in relation to the problems of soil acidity.

SAINT, S. J. The relation between the P_H, the lime requirement, and the thiocyanate colour of soils.

FISHER, E. A. Base exchange in relation to adsorption.

FISHER, E. A. Base exchange in relation to swelling of soil colloids General discussion. L. G.

Estimation of Titanium in Minerals, Ores and Industrial Products.

BARNEBY, O. L. and ISHAN, R. M. *Zeitschrift für analytische Chemie*, Vol. 65, No. 9, 1925.

The paper deals with the gravimetric, volumetric and colorimetric methods for the estimation of titanium in different substances, as suggested by various authors, and quotes the corresponding literature.

NIKLAS.

An Inquiry on Liming and into the Best Means of Extending the Practice.

Enquête sur le chaulage et les moyens propres à developper la pratique de cet amendement. *Bulletin de l'Office de Renseignements agricoles*, Ministère de l'Agriculture. Paris, August, 1925.

VIII Region: South.

Two parts: East of the Rhône (Cévennes). West of the Rhône (Provence).

A. *Cévennes and Languedoc.*

Ardèche Department: Consists on its central massive of granitic, Jurassic, Cretaceous and volcanic beds, and has large valleys running down to the Rhône.

Important lime-burning kilns exist at Teil and at Viviers, but, very little liming is done in the Vivarais.

Gard Department: The granite Cévennes are the home of the calcifuge chestnut-trees. On descending into the valleys alluvium is found; Gardons, Cèze are poor in lime, but quite fertile notwithstanding.

The Pliocene deposits in the South of the department are completely lacking in lime. Despite this the practice of liming is very much neglected in this vine-growing department.

Aude Department: the tertiary calcareous strata are neither vine-growing nor limed. They do not lime regularly, in this district, because it requires about 1500-2000 kgs. per hectare every 4-5 years for the granites, schists and mica-schists of the Black Mountains.

Department of the Pyrénées. East: the soils are of very varied composition, and the practice of liming is neglected.

B. *Provence.*

Vaucluse Department. Entirely calcareous.

Department Bouches-du-Rhône. Generally rich in limes, nearly 20-25 % in the alluvium of the Rhône.

Only the stony plain of Crau (diluvium) is lacking in lime. But it is not intensively cultivated except the parts irrigated by the water of the Durance, which also contains lime.

The magnesian lime (dolomite) and calcium cyanamide give good results in the Durance valley.

Drôme Department: only a small portion is granitic, the rest is sufficiently calcareous. Except on the molasse or Pliocene plateau often clayey and in the low valleys of the Drôme, Valloire, Galaure, Bancel, Herbasse and Isère, the practice of liming is neglected.

Basses-Alpes Department: the cultivated areas are generally provided with sufficient lime.

Var Department: there is a lack of lime in the Maure and the Esterel massives. The scarcity of manure causes liming to "scorch" the soil. The lime-kilns are disappearing.

In the market-gardens of Hyères basic slag is used.

Alpes-Maritimes Department: No liming is done. To the east of Cannes the granite-triassic massive is planted with the calcifuge mimosa bushes. The soils all over the department are sufficiently calcareous for the cultivation of flowers or for large-scale farming, which is not carried out beyond the tertiary marl plateau or in the alpine valleys.

Corsica.

Nearly all districts are deficient in lime. Everywhere liming is so far no more than an experiment.

It must be added that under the Mediterranean climate the practice of liming is generally neglected; in humid climates, however, lime supplements the sun and helps nitrification. PIERRE LARUE.

Methods of Estimation of Humus in Soil.

COLLINS, O. *Engelhardtsche Versuchsstation.* No. 2.

The application of ISCHTSCHEREKOFF'S method of humus estimation in soils in the agrochemical laboratory of the ENGELHARDT experimental station did not yield accurate results. Better results were obtained by using 1-2 grams of soil instead of 0.5 gram. for an analysis and heating this to boiling point with 50 cc. of water and 20-25 cc. of 10 % sulphuric acid. To this is then added the required quantity of potassium permanganate and the whole is boiled for an hour. The humus content of a soil can be estimated with great accuracy by heating the soil with permanganate and sulphuric acid and absorbing the evolved carbon dioxide by means of caustic potash. The mixture of caustic potash and soda is analysed by WINKLER'S method. AUTHOR.

Manual of Mineralogical Chemistry.

DOELTER, C. and LEITMEIER, H. *Handbuch der Mineralchemie.* With many illustrations, tables and diagrams. Four volumes. THEODOR STEINKOPF, Dresden and Leipzig, 1925.

This already reviewed and well known work is continued with the two volumes now published. Vol. II, 11 (iron ores) and Vol. IV, 2 (copper and iron sulphides, silver sulphide, ores and tetrahedrite).

SCH.

The Estimation of the Very Small Quantities of Iodine.

FELLENBERG, v. Th. Die Bestimmung Kleinster Mengen Jod. *Zeitschrift für analytische Chemie,* Vol. 65 (1925), No. 8, pp. 326-332.

The author who studied the occurrence of minute quantities of iodine in nature and the question of iodine metabolism in general at the request of the Swiss Crop Commission, gives in this paper a number of methods which can be used in estimating very small quantities of iodine, as they are found almost everywhere. Quantities from 0.01 gm. to the 10 millionth part of a gram can be estimated. The author deals with the quantitative estimation, the colorimetric estimation, the separation of organically and inorganically combined iodine, as for example iodine in water (sea-water) in salts (rock salt) in minerals, in soils, in plant and in animal substances, etc. He also investigates the content of iodine in the case of iodised salts. For further particulars see *Biochem. Ztschrft, 142,* 246 (1923); *152,* 116, 128, 132, 135, 141, 153, 172, 185 (1924). *Mitt. Lebensmitteluntersuchung u. Hyg., 14,* 161, 305 (1923); *14,* 185 (1923). *Biochem. Ztschrift, 152,* 116 (1924).

NIKLAS.

The Determination of the Cations found Adsorbed in Soils by the Hydrochloric Acid Method.

GEDROIZ, K. Die Bestimmung der im Boden in adsorbiertem Zustande befindlichen Kationen nach der Salzsäurmethode. *Journal f. Experim. Agronomie,* 1924.

I worked out a method for the determination of the cations found adsorbed in the organic and inorganic parts of the soil, namely by their displacement by the ammonium ion from ammonium chloride (see my work in *Journal Experim. Agronomie,* vol. XIX, (1918), p. 226). As the result of further experimental work a new method is now proposed which by using cold hydrochloric acid of low concentration is not only much simpler and much more convenient than the former one, but what is also of great importance, much cheaper. This new method is based on the observation that, on treating a soil with hydrochloric acid of concentration not higher than 0.05 N., an exchange of cations takes place between the hydrochloric acid and the zeoliths of the soil, but there is no dissolving.

The course of an analysis with this method is as follows : The soil sample (5-25 gms. according to its content of adsorbed bases and the completeness of the analysis) is treated in the cold with 25-50 cc. of 0.05. HCl (special accuracy is not required) in a porcelain basin of moderate size, then filtered through a filter paper (hardness 602) and washed with the same acid until the washings show a negative tests for calcium. The filtrate is then treated in the manner usual for hydrochloric acid extracts.
AUTHOR.

The Ultramechanical Composition of the Soil and its Dependance upon the Adsorption of its Occurring Cations. Liming as a Means of Improving the Ultramechanical Composition of the Soil.

GEDROIZ, K. Die ultramechische Zusammensetzung des Bodens und ihre Abhängigkeit von der Art des im Boden in adsorbiertem Zustande befindlichen Kations. *Journal f. Experim. Agronomie*, 1924.

In a previous paper the author has shown that the colloid nature of a soil, as estimated by its swelling, is in close relation to the adsorption of its cation. In this paper an account is given of experimental work which proves that the mechanical and especially the ultramechanical composition of a soil (the fraction < 0.001 mm.) is changed according to which cation saturates the adsorption complex of a soil. Investigations were carried out with reference to the action of Na, NH_4, K, Mg, Ba, Al, Fe and H in replacing the naturally adsorbed bases (Ca and Mg).

All soils investigated by the anthor which contained as adsorbed bases only Ca and Mg, and even the most loamy types of soil, did not show the presence of particles of colloidal size (0.25 micron) ; and even after the application of methods recommended for the preparation of soils for mechanical analysis the soils did not show more than 1 % of such particles. The substitution of the adsorbed Ca and Mg by the cations of Mg, H, K, NH_4 and Na increased the number of colloidal particles present in the order indicated, i. e. least on substitution by Mg and most on substitution of Ca and Mg by Na. The supplying of the soil with the cations of Ba, Al or Te on the other hand decreased the number of these colloidal particles. The author deals very exhaustively with the question of pentration of Na and H cations into the adsorbed soil complex and the influence of that penetration mainly in view of the occurrence of such penetration in nature (alkaline soils or solonetz, which contain adsorbed Na by unsaturated bases, podsol soils which contain H). The aggregates of colloidal soil particles (secondary particles) which occur in soils containing adsorbed Ca or Mg, and which are quite or almost undecomposed by water, become decomposable into primary particles on substitution of Ca or Mg by other cations. The action of the hydrogenion is very weak in this respect. However, soils saturated with repect to the hydrogen-ion contain quantities of colloidal particles which influence profoudly the physical properties of the soils. On the other hand, the action of Na in this respect is extraordinarily strong. Thus while an analysis of a loamy soil sample in its natural condition, i. e. the

adsorbed bases being Ca and Mg, gave 39.9 % of the particles as being < 0.001 mm. and from among those only 1.3 % particles of 0.22 micron, the substitution of the adsorbed Ca and Mg by Na gave 59.8 % of particles as being < 0.001 mm., while from among the latter as much as 45.3% were of 0.22 micron. The cause of this phenomenon is that, while the ions in a solution of a soil saturated by Ca are Ca and OH, in a solution of a soil saturated by Na the ions are Na and OH. In the latter case the stabilising action of the hydroxyl-ion on the organic and aluminium silicate soil particles is much greater than the coagulating action of Ca. Solutions of soils saturated by the hydrogen-ion and which contain in the soil solution hydrogen-ion, but, of low concentration, and whose coagulating action with Ca is also low, occupy an intermediate position and are much nearer to the soils saturated by Ca and Mg.

The same causes also bring about the different structure and unequal stability of the different soils saturated by Ca and Mg (e. g. black-earth soils), Na (Solonetz soils) and H (Podsol soils). AUTHOR.

Soils Deficient in Bases. Methods of Determination of Hydrogen-ions present in an Adsorbed Condition. The Requirement by Soils of Lime to neutralise Unsaturation.

GEDROIZ, K. Von Basen nicht gesättigte Böden. *Journal f. Experim. Agronomie*, 1924.

Experiments on washing soils with cold hydrochloric acid of different concentrations until the washings no longer give the characteristic Ca test proved that,hydrochloric acid af 0.05N. and lower concentration, has almost no action or very little on the organic part of the soil, or on the aluminium silicate part. It does not decompose them and the only reaction is to exchange its hydrogen for the bases adsorbed by the soil, which then pass into solution. The hydrochloric acid has in this case the same action as a solution of a neutral salt, e.g. of ammonium chloride. The hydrogen ion has the same capacity as other metallic cations of penetration into the adsorbed soil complex (into the zeolitic and humous part of the soil) and of displacing the adssorbed bases present. Correspondingly all cations are equivalent in this respect and their penetration into a soil displaces from the latter equivalent amounts of adsarbed soil bases.

These investigations enable a deeper insight to be obtained into the nature and origin of soils which are deficient in bases, and to devise a more scientific method of determination of the degree of unsaturation of such soils with regard to bases. A soil unsaturated by bases is a soil whose adsorption complex contains a hydrogen-ion, the latter having the property of being able to be displaced by any other metallic cation. For the determination of the amount of hydrogen-ion present in the soil, i. e. its degree of unsaturation by bases, the same methods of displacement may be used, which are in use in the determinations of the other adsorbed cations which may be found in soils. The most suitable salt for the displacement of the hydrogen-ion is $BaCl_2$ (1-0.5N.). The soil is treated

on a filter-paper with such a solution until the displacement of the hydrogen-ion is complete — as shown by methyl orange. The amounts of free hydrochloric acid in the washings is determined by titration. This method of determination of the degree of unsaturation of a soil with regard to bases, serves at the same time as a determination of the lime requirements of the soil, as a neutraliser.

The investigations of soils, when all adsorbed bases have been displaced, by treating them with 0.05 N.HCl show that: (1) the adsorbed hydrogen-ion can again be displaced by any desired cation;

(2) the decomposing and dissolving action of water on the organic and aluminium silicate adsorption complexes of the soil is considerably greater in the case of soil saturated by hydrogen-ions than in those saturated by bases,

(3) the process of podsol formation in soils is, from a chemical point of view, characterised by two stages: (*a*) the atmospheric water trickling through the soil displaces in the end all the bases present in the adsorbed soil complex by its hydrogen-ions; the presence in the water of free acids increases that displacing action of water, while, on the other hand, the presence in the soil of easily soluble salts or carbonates of Ca and Mg (in greater or smaller quantities) prevents this exchange of hydrogen-ions for the bases present in the soil; these salts protect the soil against podsol formation by the action of atmospheric water, and only when these salts are removed can the podsol formation begin.

(*b*) Simultaneously with the formation — in the above described manner — of organic and mineralogical adsorption complexes deficient in bases — proceeds an energetic washing-out action of these complexes from the soil; the soil becomes deficient in zeolitic and humous components.

The lime which serves as a means of decomposing and neutralising the unsaturated basic compounds, at the same time protects the soil against the destruction and removal of its most valuable part the adsorption complexes. AUTHOR.

The Disintegration of Beton by the Chemical Action of Soil Water.

GESSNER, H. Betonzerstörung durch chemische Einwirkung des Grundwassers. Agrochemical laboratory of the E.T.H. *Schweizerische Zeitschrift für Strasservesen*, Nos. 5 and 6, Zurich 1925.

The author hopes that this short abstract of his work will be forgiven him in view of the enormous practical importance of the problem and with which the soil-scientist has occasionally to deal, and in view of its importance in the use of cement drain pipes in soil improvements.

The author, as a chemist to the Swiss Commission for the Investigation of Cement Pipes in Improved Soils, has studied a large number of cases of disintegration and has carried out analyses. The analyses included soil sections, soil solution as well as drainage water, and beton in very different stages of disintegration. The abstracted work is written

mainly for the building expert and contains therefore as few chemical references as possible.

As a result of two years study the following conclusions are drawn; Injurious to cement are:

(1) Strong acids- these do not occur in nature, but are found in the industrial refuse-waters;

(2) Weak acids, carbonic acid, "humic" acid, i. e. organic complexes found in the soil and reacting as acids — found often in soils free of lime and in soil waters;

(3) Acid action of apparently neutral soils, liberated by neutral salts. Found very often in peat soils and much more seldom in mineral soils (soils whose water extract has a neutral reaction, which, however, show a degree of acidity by the BAUMANN-GULLY method).

(4) Sulphates found in flat moor land as gypsum, more rarely in mineral soils, gypsum waters and chimney gases;

(5) Magnesium salts- found in mineral soils, very often in soils rich in lime, more rarely in peat.

The chemical action of acids is quite clear in view of the alkaline character of Portland cement. Large amounts of carbonic acid may lead to complete destruction, and the same result can be brought about by the acid reaction of apparently neutral soils, which is due to the cation exchange — H-ion against the alkali-ion or alkaline earth-ion and which is caused by the neutral salt.

Sulphate disintegrations have been known for a long time under the name of "gypsum drive", due to the crystallisation in the cement of the calcium-sulpho-aluminate which has a very high water of crystallisation.

The action of the magnesium salts, which are present in soils rich in lime mainly in the form of the carbonate, is probably due to the exchange of the Mg-ion for the Ca-ion of the cement gel, and on account of their higher hydration have a softening action on the beton. In general, the most dangerous and the most injurious conditions for any beton object are those brought about through the change in the soil water level, which causes the object that at one time was surrounded by water, at another time to be under dry conditions.

A number of examples from the literature and from the author's own practice are quoted and treated in greater detail and explained by means of two photographs.

As precautionary measures are suggested the production of a particularly dense beton (by pressing, stamping, fat mixing), together with a careful working and long storing of cement objects. There is not enough experience available about special forms of cements or of special coating as preventives. AUTHOR.

The Disperse Systems of the Soil.

GLINKA, K. Die dispersen Systeme im Boden. Leningrad, pp. 1-75.

The author gives a short account of the Russian and western work dealing with disperse systems and their relation to soil Science. The

object of the work is to give an explanation of the origin of the different soil types. This brief work contains the following chapters:

1. The conception of disperse systems.
2. Soil suspensions.
3. Soil colloids
4. Adsorption phenomena in suspensions and colloids.
5. Electric adsorption and coagurlation.
6. Mutual coagulating action of colloids.
7. Protective action of the humus-soils.
8. Chemical adsorption in soils.
9. Adsorption of gases and liquids (water).
10. Soil solutions.
11. Origin of different soil types in the light of dispersoid chemistry:

(*a*) Origin of the laterite type
(*b*) » » » podsol »
(*c*) » » » steppe »
(*d*) » » » solonetz »
(*e*) » » » moor and solontschak type.

AUTHOR.

Investigations on the Acidity of Soils in the Neighbourhood of Leningrad.

GLINKA, K. Kurzer Bericht über die Untersuchung der Azidität der Böden. *Annals of the State Institute of Experimental Agronomy,* Part III, No. 1, 1925, Leningrad.

The author has investigated the active acidity and exchangeable acidity of the podsol, gley-podsol, moor and Bendzina soils. The active acidity was determined by means of indicator methods as well as by electrometric methods (with quinhydron electrode). For the active acidity the following conclusions can be drawn:

(1) The upper soil surface (A) has the maximum acidity.

(2) The low-land moor soils generally have a P_H value of 5.5-6.0.

(3) The podsol and gley-podsol soils give a maximum value for acidity when the soil sample is taken from forests. The P_H value is then 4.5 (very seldom 4.8). Arable soils of similar morphology show lower acidity (P_H 5.5-5.8-6.0-6.2).

(4) The gley soils are the least acid, and their deeper layers may even show a neutral or weakly alkaline reaction.

(5) The bendzina soils are almost neutral in their upper laxers, while their lower levels may even show an alkaline reaction (P_H 7.7-7.8-8.0).

For the exchange-acidity using the method of Prof. GEDROIZ the following results were obtained:

(1) The upper soil surface (A) has the maximum acidity.

(2) The non-moor soils have a very slight acidity, which may be for the upper layers 0.0004 % H.

(3) The maximum exchange-acidity for the soils taken from forests was 0.002-0.0035 % H for the upper layers. AUTHOR.

A Simplified Method for the Determination of Lime in S oils.

GROSSFELD, J. Vereinfachte Verfahren zur Kalkbestimmung in Ackerböden. *Zeit. f. Pflanzenernährung und Düngung,* Vol. No. 1-2, pp. 93-103. Leipzig, 1925.

The author describes for the determination of limes in soils an indirect and a direct method which both give good results.

The first consists in evaporating to dryness in a platinum capsule the soil solution obtained by mixing 150 gm. of air-dried soil with 300 cc. of hydrochloric acid (S. g. 1.15), then heating the mixture for an hour to boiling point. After allowing to cool, it is heated to redness and 20 cc. of a 2 % solution of ammonium oxalate are added and a certain amount of soda, and then oxalate of lime; it is evaporated to 100 cc., filtered through a fine filter paper and the excess of oxalate determined by means of a solution of permanganate.

With the direct method, the soil solution is made almost neutral and 4 % ammonium oxalate added and, afterwards, 25 % sodium and ammonium acetate. The solution is filtered through fine filter paper, and is first washed with cold and then with hot water; the precipitate is dissolved in hot 10 % nitric acid and then washed with water and titrated with permanganate solution. With this method the most exact results are obtained with clay soils. A. F.

The Physical Properties of Forest Soils and their Relation to Soil Acidity.

NEMEC, A. and KOAPIL, K. Einige physikalische Eigenschaften der Waldböden. (From the Biochemical Institute of the State Experimental Station for Forestry Investigations, Prague). *Zeitschrift für Forst- und Jagdwesen,* Year 57, pp. 540-567, tables 6.

Continuing their investigations on the influence of pure coniferous and pure deciduous trees and of mixed coniferous and deciduous stands on mineral soils, the authors have investigated certain Bohemian forest soils, of very different geological origin, but they have restricted their investigations to the active acidity and to some of the physical properties of the soils. They thus investigated alluvial sandy-clay and clay soils, chalk formation sand soils, primary formation sandy loam-soils and (Sozän) sandstone clay soils. Space does not admit reproduction of the tables appended to the original paper, but the general conclusions given by the authors are as follows:

The unfavourable physical properties of soils of dense *purely coniferous* tree stands result in an accumulation of strongly acid humus (upper surface humus) which cause a diminishing air capacity and these two causes together, strong acidity and lower air capacity, are the main reasons for the failure of the natural rejuvenation. Timely removal of

the upper layer, by bringing about an accelerated litter decomposition will counteract these unfavourable conditions. More openly grown stands show therefore always a lower acidity and a higher air capacity. The absolute water capacity is in general inversely proportional to the absolute air capacity.

Also, close *purely deeciduous* tree stands show a relatively small air capacity, although the soil ventilation is usually in this case much more favourable than in the case of purely coniferous tree stands. The relation, acidity-air capacity, is in the case of purely deciduous tree stands not so close as in the case of purely coniferous stands, although there is a resemblance.

In soils of *mixed tree stands* the air capacity undergoes considerable variation. A direct relation between it and acidity could not be traced, even approximately. In humus-covered, vegetation-free forests, with mixed tree stands, a much higher air capacity was found than in the case of dense coniferous or deciduous stands when grown on soils of corresponding formations.

The absolute air capacity is, in the case of mixed tree stands, in general much smaller than in the case of loose, well lighted deciduous formations.

The authors then study the relation between their results and the most important CAJANDERS forest vegetation types. The *oxalis* type has a moderately acid soil reaction and a fairly high air capacity, the *Myrtillus* type has its optimum at a somewhat higher degree of acidity and lower air capacity, and the *Calluna* type has its optimum at the highest degree of acidity and lowest air capacity.

GROHSKOPF.

Modern Methods of Soil Investigation with Respect to the Biochemical Methods of Nutritive Content Estimation of Soils and the Effect of Inoculation.

NIKLAS, H. Die moderne Bodenuntersuchung insbesondere zur Ermittlung des Nährstoffgehaltes der Boden und des Verhaltens der Boden bei der Impfung. *Tonindustriezeitung*, No. 14, 1925.

After a short consideration of the results obtained in the soil reaction investigations at the Agrochemical Institute of the High-School of Weihenstephan, the author gives an account of the stage reached by him and his collaborators in the biochemical investigations, begun at the suggestion of CHRISTIANSEN and STOKLASA, on the nutritive-content estimation of soils and their behaviour towards inoculation. The question of the inoculation of soils, especially with nitrogen fixing bacteria, seems to depend primarily upon the conditions, and only investigations concerning this point, together with the employment of biochemical methods, will enable us to say with certainty what are the conditions for making bacteria-free soils capable of inoculation.

AUTHOR.

Determination of the Reaction and the Lime Requirements of the Pfalz Soils.

NIKLAS, H. and HOCK, A. Bestimmung der Reaktion und der Kalkbedürftigheit von Böden der Pfalz. *Praktische Blätter der Bayerischen Landesanstalt für Pflanzenbau und Pflanzenschutz,* 1923, No. 8-9-10.

A number of soil samples taken from very different geological formations of the Bavarian Rhine-Pfalz have been investigated by various methods, and the results obtained are shown in tabular form. It was proved that the geological conditions are of primary importance in determining the reaction and the lime requirements of a soil, but within the same formation local influences and the particular cultivation of the soil may also be of greater or less importance. NIKLAS.

Colorimetric Reaction Investigations of Soils in Agricultural Practice.

NIKLAS' and HOCK, A. Die Reaktionsuntersuchungen der Böden mit kolorimetrischen methoden in der landwirtschaftlichen Praxis. *Tonindustriezeitung* 1925, No. 33.

The authors report on the results obtained in tests carried out with an apparatus made by the firm of E. MERCK, Darmstadt, for field investigations of soil reactions. From consideration of the results obtained they conclude that the field method is unsuitable and that soil reaction, investigations must be carried out in scientific institutions. NIKLAS.

The Nature of Soil Acidity in Forests Soils.

NIKLAS, H. and HOCK, A. Zur Frage der Bestimmung der Formen der Bodensäure in Waldböden. *Forstwissenschaftliches Zentralblatt,* 47, 1925.

The authors point out that, just as in the case of arable soils so in the case of forest soils we should not only determine the actual acidity, but the titrational and exchange acidities as well. Using electrometric titration methods and making the ordinates to represent the values of P_H thus obtained and the abscissae to represent the quantities of alkali used, a series of characteristic reaction curves results in the case of forest soils, from which the manner of their acidification can be derived. Strongly dissociated acids, e. g. the exchange acids conditioned by aluminium salts, gave a slowly rising curve, which on completed neutralisation by addition of a very small quantity of alkali, rose very steeply from the neutral point, through several P_H values, to a quite considerable P_H value. From other experiments the author showed that soils with exchange acids contain mainly acid aluminium salts, which give curves very similar to the above, and hence from the curves resulting on soil titration it can be easily shown whether the soil contains exchange acid or humous acids. The latter acids are also shown, in a table appended to this paper, to give very characteristic curves. The paper does not say how ar it is possible by using electrometric titration to determine the buffer

properties of a soil and also to find whether a neutral soil contains sufficient buffer substances to permit the development of bacterial life.

NIKLAS.

The Importance of Carbonic Acid as a Fertiliser.

NIKLAS, H., SCHARRER, K. and STROBEL, A. Die Bedeutung der Kohlensäure als Düngemittel. *Zeitschrift für angewandte Chemie*, 38, 251, 1925.

The previous work on this question is exhaustively reviewed and discussed. The experiments described were carried out with carbonic acid fertilisers produced by the chemical works Bayern at Reichertshofen near Ingolstadt. This fertiliser consisted of 50 % peat, 45 % wood charcoal and 5 % lignite. It had a very favourable influence on many plants, especially potatoes. As to the question of fertilisation with carbonic acid, it is necessary to continue the investigations for a number of years to settle finally the effectiveness or otherwise of carbonic acid fertilisers.

K. SCHARRER.

Investigations on the Reactions and Lime Requirements of Soils, Carried out by the Institute of Agricultural Chemistry of the High-School of Weihenstephan during 1923-24.

NIKLAS, H. and VOGEL, F. Bodenuntersuchungen auf Reaktion und Kalkbedarf durch das agrikulturchemische Institut der Hochschule Weihenstephan. *Landwirtschaftliches Jahrbuch für Bayern* 1925, Nos. 5-6.

After a short description of the methods applied an account is given of the results obtained from 2255 soil investigations carried out by the Institute. Of those investigated, 50 % have been found to be weakly to strongly acidic, 15 % neutral and 35 % alkaline. Of 1285 soils samples sent in by official Bavarian stations, and investigated by various methods by A. HOCK, 34 % were found to be absolutely lime deficient, 23 % required only a limited lime supply and 43 % required no lime. It could also be shown that the geological conditions of the soil were of primary importance in determining the character and the lime requirements of a soil. It was further proved that quantitative methods by themselves give a very superficial, and in most cases very erroneous idea of the true condition, and a warning is given as to their use in actual practice. In an appendix, tables are given of the reactions shown by the different soils sent in from official and private sources, and they also show the total acidity of the soils. Also, the soils belonging to the different geological formations are arranged according to the same scheme. In addition, a description is given of the methods used in taking samples, an example of the questionnaire used is given, and an explanatory note is given relative to the informations published by the Institute.

NIKLAS.

An Account of Experiments from the Unpublished Work of the late Alfred Koch. A Contribution to the Knowledge of the Nitrogen Activity of Arable Soils.

RIPPEI, A. Versuche aus dem Nachlass von ALFRED KOCH. *Journal für Landwirtschaft*, 72, No. 1, 17, 1924.

The experiments described briefly in this paper include experiments on fallow land as well as continuous cultivation experiments with winter crops and pastures, experiments with buried cylinders on fallow soil, on spontaneous growth experiments, pot experiments on the nitrogen activity of soils from different depths, and finally experiments to determine the influence of various organic substances on the nitrogen capacity of different soils. The author does not share the late A. ROCY'S view as to the considerable evolution of nitrogen during a crop root fallow, and he believes himself to be supported in his opposite views by the experience gained from the twenty years' fallow land experiments carried out on the land of the Institute of Agricultural Bacteriology of the University of Göttingen. He admits that A. KOCH probably had in mind the possibility, but not the fact, of a nitrogen fixtion during a fallow. He does not go deeper into details or into less important questions, neither does he review the literature on the subject. NIKLAS.

The Preparation of Magnesium-Ammonium Phosphate in the Estimation of Phosphoric Acid or Magnesium.

SCHMITZ, B. Ein Beitrag zur Herstellung des Magnesia-Ammoniumphosphatnie derschlages für die Bestimmung der Phosphorsäure bezw des Magnesiums. *Zeitschrift für analytische Chemie*, vol. 65, Nos. 1 and 2, pp. 46-53, 1924.

The author bases his investigations on the previous work of H. NEUBAUER, an abstract of which was published in the Journal in 1894.

NIKLAS.

The Organic Substances of the Soil.

SCHMUCK, A. *Transactions of the Kuban Agricultural Institute*, Part I, No. 2, 1923, pp. 1-92, Krassnodar.

In the first part of his work the author gives a review of the literature on the nature of soil organic substances and particularly on humic acid. The following conclusions were drawn:

(1) The organic compounds in the soil form a complex mixture consisting of very different organic substances. The greater part of the organic substances isolated from the soil by American workers are not invariably present, but are in close relation to the former cultivation of the soil.

(2) The greater part is of a different nature and forms a characteristic organic compound, whose content varies in different soils.

(3) A considerable part can be separated by solution in alkalies and precipitation by acids as humic acid.

(4) Chemically, it represents a nitrogen containing substance of an acid type.

(5) The acid character is due ,partly to adsorption by the colloidal humic acid and partly to the presence of carboxyl groups.

(6) The salts of humic acid are not true salts formed in stoichiometric proportions, but, complicated chemical and adsorption compounds.

(7) The solubility of humic acid in water is slight, and the transition from the soil-state depends upon the presence of suitable protective colloids. Under suitable conditions, the formation of a stable colloidal solution is fairly easy, that solution then showing all the properties of organic emulsions.

(8) The nitrogen containing part of the humic acid resembles albuminous substances and gives similar hydrolytic decomposition products.

(9) The albumin of the organic substances of the soil are not exclusively plasm-albumin, since they ar not accompanied in the soil by glycosamine.

(10) Humic acid contains benzene ring compounds.

(11) The unsaturated character of the compound is shown by its easy combination with halogens and its easy oxidation with alkaline $KMnO_4$.

(12) The hydroxyl groups enter, most probably, the side chains in the benzene ring of the humic acid.

(13) The ash of humic acid is mainly the ash of the albumin.

In the second part the author describes experimental work on humic acid. He isolated from the soil 300 gm. of a substance usually regarded as humic acid. The substance had a somewhat complex composition and gave besides slight amounts of substances soluble in ether benzene, ligroin and chloroform, about 14 % colophonic acid and calophonic ester and about 80 % of a specific substance to which the name humusic acid was given.

This substance had a decidedly acid character and contained both hydroxyl and carboxyl groups. It is colloidal and may occur in two forms, soluble and insoluble in water. When freshly precipitated from alkaline solution it is fairly soluble in water, but does not diffuse through membranes.

Analysis gave the following percentage results, calculated as ash-free substance, C-61.8, H-4.2, N-3.2. The ash is not organically combined with the substance and is only a difficultly separable admixture. There is no doubt that the nitrogen contained in it is in the form of ordinary albumin compounds. On prolonged hydrolysis a part of the substance goes into solutiou, and the insoluble residue contains only small amounts of nitrogen. The author believes that a chemical analogy indeed exists between the albumin, the artificial humic bodies and the humusic acid of the soil.

These compounds are remarkable for their low H and N content and their high C and O content. A further analogy consists in the fact that

all of them correspond approximately to the composition $(C_5 H_4O_2)_n$ With such a structure they must contain a large number of double forms and should give condensation products. The author considers that from very different complex organic compiunds, by the splitting off of coater, and condensation, similarly constituted substances can be obtained, and hence, that humic acid can be obtained from many widely differing substances. AUTHOR.

Methods of Estimation of Phosphoric Acid in Soils.

SCHTSCHEPONOWSKY, A. Zur Methodik der Bestimmung des Phosphorsäuregehaltes im Boden. *Engelhardt's Versuchsstation*, No. 2.

The SONNENSCHEIN method for phosphoric acid estimation in soils so largely used by agricultural chemists, is unsuitable for two reasons. Firstly, its use in volumetric analysis is very inconvenient, and secondly it does not yield sufficiently accurate results, because the treatment of the soil with the common acids — H_2SO_4 and HNO_3 — introduces impurities.

The purpose of this work was to find a method which would yield, in volumetric analysis, better results than SONNENSCHEIN'S method and after a large number of experiments this was found in NIESSEN'S method. The phosphate in the soil is precipitated once with a molybdate solution and after dissolving in standard caustic potash solution, the solution thus obtained is titrated with H_2SO_4. But, since the solution must be pure, an attempt was made to oxidise and dissolve the phosphate by first treating every 10 gm. of soil with 50 cc., or more, of 0.1N. permanganate solution, acidified with sulphuric acid, and then boiling for half an hour. The residue left in the permanganate is then decomposed with oxalic acid and the solution diluted with water to 250 cc. For the phosphate estimation by NIESSEN'S method 50 cc. of solution are taken. AUTHOR.

On the Adsorption of P_2O_5 by Soils.

SOKOLOW, A. Ueber die Adsorption des $P_2 O_5$ durch den Boden. *Engelhardt'sche Versuchstation*, No. 2.

The author estimated the adsorption of P_2O_5 in relation to the amount of combined lime. For that purpose he increased the lime content an: then displaced it byNH_4. 100 gm. absolutely dry soil contained in mgm.:

	Combined lime	Adsorbed P_2O_5
Original soil	411	341
Soil treated with $CaCl_2$	588	609
» » » NH_4 Cl	—	11

AUTHOR.

The Origin of Alkaline Soils (from the Russian).

VILENSKY. *La Pédologie*, 36-58 pp., 1924.

Alkali soils differ from acid soils by the fact that their upper surfaces show an almost complete absence of easily soluble salts, while deeper down is a solid surface nearly impermeable to water. Below this surface are found NaCl, Na_2SO_4 and Na_2CO_3. From his investigations and studies, the author arrives at the following conclusions: The salt soils were formed in those places where the ground water through capillary attraction reached the upper soil surface and evaporated. Alkali soils were formed from the salt soils when rain-water again reached the lower layers and washed out the salts. They then affected the undersoil. This theory agrees with the views of geologists on the question of climate after the ice-age. According to those views the then higher temperatures brought about the formation of deserts and hence also of salt soils further North, which soils were later by the above process converted into alkaline soils. HELLMERS.

Salt Soils, their Origin, Composition and Methods of Improvement (from the Russian).

VILENSKY, (New Village), Moscow, 153 pages, 1924.

This work deals with the Russian salt soils of the region of the lower Volga and distinguishes between wastes and half wastes, the dry steppes and black-earth, the forest steppes and forest zones. The author has carried out analyses of all these different types and of samples taken from different depths, and made also both total analyses as well as analyses of water and hydrochloric acid extracts. In the next chapter, in greater detail, the flora of the salt soils is dealt with and an interesting table is given showingwhat salt concentrations of NaCl, Na_2SO_4, Na_2CO_3, $NaHCO_3$ and $MgIO_4$ the different cultivated plants can tolerate. Then follows a chapter on the origin of the salt soils and their place in the general soil classification, and it is shown that there exists no sharp line of demarcation between salt soils and alkaline soils. In conclusion the author points out the importance of salt soil investigations on the general question of the history of the earth in the post-glacial period. HELLMERS.

The Importance of Gypsum in Agriculture (from Latvian).

VITINS, J. (WITYN, J.). Riga, pp. 44, 1925.

The author draws attention to the very numerous gypsum deposits found in Latvia. They are found in the Devonian loam deposits, and in some places reach a thickness of 3-4 metres. In some places the deposits are found almost on the surface. The water of many springs contains dissolved gypsum. Thus for example, the main springs at Kemmern yield annually about 700 cc. of dissolved gypsum, and the whole

neighbourhood of Kemmern yields about 2000 cubic metres. Even the sea at Kemmern is richer in gypsum than anywhere else in the Baltic.

The author discusses the questions of fertility and of exhaustion of the soil, the question of the profitable and unprofitable years on different soils in the temperate climatic zone, and arrives at the conclusion that in the temperate zone the coagulation of the fine soil products under the influence of electrolysis is of paramount importance.

The soils in the temperate zone contain usually only inappreciable amounts of divalent cations. Rich crops are obtained especially after severe winters, when the soil gets frozen through, or in in dry summers. The coagulating capacity of the divalent cations must be increased by the frost and by the dryness. The unprofitable years are a common experience on acid podsol soils and are due to a lack of divalent cations (particularly of Ca). But unprofitable years occur also on neutral soils, when the soil has not been manured for several years in succession, when the amount of precipitation was considerable and when no freezing through or drying out of the soil has taken place. To illustrate his statements the author gives several examples which show an increase in the degree of dispersion produced by precipitation. From this point of view gypsum is an important and a cheap means for keeping the fine soil particles in a state of coagulation. According to the author, 1 part of gypsum to 10 000 parts of water suffices to bring about a settling of the fine particles of a soil in 24 hours, while a 3-4 times stronger concentration is necessary to cause the settling of the fine particles of a more acid soil.

The author next considers sulphur as a plant food and the quantities of sulphur which are supplied to the soil by the atmosphere and through dung manuring. Hence he concludes that sulphur may be present in podsol soils in minimum quantities even without their being manured with superphosphate, especially if it is cultivated with hoed crops or Papilionaceae. Also in these cases gypsum may be of importance. Finally, he points out the importance of gypsum as a means of removing the alkaline reaction of a soil caused by the presence in it of sodium and potassium carbonate. This was known for a long time in the case of solonetz soils, but it is of special importance in gley and podsol soils, where excessive liming gives negative results. The author mentions the types of soil on which the experiments with gypsum should be tried, and assumes that the doses of phosphoric acid fertilisers could have been diminished if gypsum had been used.

In the opinion of the author, gypsum should be of great importance in the case of loamy soils when potatoes, rye and certain types of hoed crops, which require loose soils, are cultivated on them. Certain experiments with clover have shown that when using gypsum in the case of heavy very acid soils, the amount of phosphoric acid present may be a minimum. The use of gypsum in the case of clover on light, acid soils, which are available for the deeply rooted plants have yielded very good results.

L. Frey.

I. The Principal Phases of the Podsol-Forming Process. — II. The Fertility of the Soil in its Relations to Soil Acidity.

(A summary of some soil investigations in Latvia).

WITYN, J. An address given at the IV International Soil Science Congress, Rome, 1924, pp. 32, illustrated, Riga, 1924.

I. The author considers briefly the phases of podsol formation in Latvia, and the subsoils, and different heights of the ground water level. With regard to the ground water the author distinguishes three cases (1) where the water level lies very deep; (2) where water level lies near the upper surface; (3) where the water passes to the upper surface. In the first case the author considers in greater detail the soil development on the following subsoils (1) loams with 20 % $CaCO_3$, silt content 20-30 %; (2) sandy loams with about 10-15 % $CaCO_3$ and about 10-20 % silt, (3) moraine detritus with high $CaCO_3$ content; (4) Sand. In the second case he deals in detail with soils whose subsoil is (1) marl-clay, (2) sand. For the third case the formation of the different deposits is closely dependent on, and is characterised by the composition of the ground water. All the cases mentioned are illustrated by soil sections.

II. The second part is a brief summary of the principal conclusions arrived at by the author in his second work (see J. VITINS (J. WITYN) "*The richess and the Fertility of Soils*". Riga, 1924). L. FREY.

Soils and Vegetation.

The Influence of Titanium on Plant Production.

BLANCK, E. and ALTEN, F. Ein Beitrag zur Frage nach der Einwirkung des Titans auf die Pflanzenproduktion. *Journal für Landwirtschaft*, 72, No. 2, p. 103, 1924.

The authors tested the results obtained by ANTONIN NEMEC and VACLAV KÁŠ, who obtained by the use of Titanium a considerable increase in the yields of mustard, peas and lucerne, and who therefore ascribed to it specific functions in the process of assimilation. Increasing admixtures of Titanium to the fertilisers gave increasing yields and a maximum yield was obtained on addition of 0.5 gm. of sodium titanate. BLANCK and ALTEN were unable, with the same experimental arrangement, to confirm the above results, and even the application of colorimetric methods did not show that any ascertainable amounts of Titanium had been taken up by the plants. No secondary effects could also be shown, hence they conclude that Titanium, at least in the form of sodium titanate, has no influence on the production of plants.

NIKLAS.

A Plant Test with "Asahi-Promoloid".

BLANCK, E. and ALTEN, F. Ein Vegetationsversuch mit « Asahi-Promoloid ». *Journal für Landwirtschaft*, 72, No. 3, p. 139, 1924.

The authors have made pot tests with this preparation which is an artificially prepared product and consists probably of a magnesium com-

pound containing also silicic acid, the action of which seems to be catalytic. To the soil fertiliser were added three known and increasing amounts of "Promoloid", which resulted in increasing yields of grain, but no increased yield of straw; the total crop was not increased. The authors intend to test these results in actual practice. NIKLAS.

Experiments on the Disintegrating Effect of Liquid Manure on the Mineral Components of the Soil.

BLANCK, E. and ALTEN, F. Versuche mit Jauchedrill bei Häfer über den aufschliessenden Einfluss des Jauche auf die Mineralbestandteile des Bodens. *Journal für Landwirtschaft*, 18, No. 3, p. 129, 1924.

The application of the PLATH liquid manure treatment in the case of rape had a much better effect than the ordinary application of liquid manure. Repeated experiments in the case of oats prove that the liquid manure treatment will not bring about an action similar to that of either nitrate of soda or of ammonium sulphate. However, other experiments with fresh pig urine on loamy soils indicate that a solvent action on the mineral components of the soil may be attributed to liquid manure. NIKLAS.

The Effect of Zeotokol (Ground Dolerite) on Plant Production.

BLANCK, E. and ALTEN, E. Zur Wirkung des Zeotokols. *Journal für Landwirtschaft*, 72, No. 3, p. 146, 1924.

In 24 zinc vessels, tests were made with Zeotokol on three different soils, maize being selected as the experimental plant. The effect of Zeotokol on the dry substance was somewhat unfavourable, while its influence on account of its supposed colloidal properties was noticeable. Hence the authors conclude that this preparation is of no value.

NIKLAS.

The Effect of Depth of Covering on the Sprouting and Early Development of Pine (*Pinus sylvestris*) Seed.

DENGLER, A. (Researches from the Möller Institute of the Forestry High-School, Eberswalde). *Zeitschrift für Forst- und Jagdwesen*, Year 57, pp. 385-468, 4 tables and 10 illustrations.

The following is a summary of the chief results:

The sprouting numbers decrease with increasing depth of covering in the case of all soils; 0.5-1 cm. of covering depth found to be the most favourable. The time necessary for sprouting increases with increasing covering depth and with the soil hardness. The percentage decrease of germintion is especially marked in depths above 2 cms. The depth of covering determines the type of sprouting. Four types of sprouting can be distinguished:

(1) Hook type; (2) claw type; (3) etiolated, stunted forms; (4) killed. GROSSKOPF.

Investigations on the Acidity of Brandenburgian Beech and Scots Pine (*Pinus Sylvestris*) Habitats, taking Typical Habitat Growths as a Standard.

HARTMANN, F. K. Untersuchungen zur Azidität märkischer Kiefern- und Buchenstandorte unter Berücksichtigung typsischer Standortsgewächse als Weiser, *Zeitschrift für Forst- und Jagdwesen*, Year 57, pp. 321-350.

The author has rendered service in showing the relation of soil acidity to the different floral habitat (arranged mainly according to CAJANDER).

From the large, partly graphic tables it is evident that the habitat growths, beginning with the most acid heather (P_H -4 and under) to sweet grass (P_H -7 and over) which prefers a neutral reaction, extend within fairly wide acidity limits, but that their optima are found within narrower and narrower limits. The same is true of the beech, although its optimum lies within much wider acidity limits, more towards the neutral side. On the other hand the Scots pine occupies a region which extends from alkaline to a very marked acidic reaction and its optima are found to occupy similar, fairly wide regions. The titrational acidity was determined by the DAIKAHARA method ; the P_H values were determined by the method of GILLESPIE using different indicators, and by the method of WHERRY using a general indicator. In the P_H determinations special attention was paid to the root depths.

GROSSKOPF.

The Development of Roots of Different Potato Varieties as shown at the Göttingen Experimental Station.

KLÄSENER, O. Wurzelentwicklung verschiedener Kartoffelsarten nach den Verhältnissen des Göttinger Versuchsfeldes. *Journal für Landwirtschaft*, 72, Nos. 1-2, 1924.

The author discusses the scanty literature on the subject, and, since the development of roots is conditioned to a large extent on the physical and chemical properties of the soil, he then describes the properties of the soil of the Göttingen Experimental Station. A description is given of the method of investigation as applied to four different potato varieties. The number of both primary and secondary roots was ascertained, their length, depth of penetration, lateral expansion and water content. It is of interest to note that both the field-plants and the pot-plants had the same number of roots. The author could not confirm the conclusions arrived at by SEELHORST and KRAUS that the worm holes do not influence the depth of penetration of the roots of a plant, but is inclined to support the opposite view of JENSEN. From his work he concluded that the potato, like all other plants, in the development of its roots, attempts to develop a definite plan as it does in the development of its aerial part. He shows also that the roots of the

four potato varieties investigated, even without lupins, penetrate to a depth of 120 cm. The lateral roots seek especially the upper soil layers, which are the most favourable for their development. The upper roots have a specific function still unknown to us.

NIKLAS.

The Fertilisation of Pasture by Liquid Manure, with Relation to the Utilisation of the Nitrogen of Liquid Manure for Green Fodder Production.

LIECHTI, P. and RITTER, E. Ueber die Wesendüngung mit Gülle. *Landwirtschaftliches Jahrbuch der Schweiz*, Vol. 35, p. 1, 1921.

The authors have studied a problem of paramount importance for the Swiss agricultural industry. The first point to settle was to find the most suitable yearly application of liquid manure for a soil. A light, to medium heavy, lime-deficient, sandy soil, was divided into a number, of meadow plots each of an area of 50 sq. metres and each manured. The exhaustive results are arranged in 13 tables, each table of several pages, and the following are the main conclusions :

(1) In a liquid manure fertilisation of grassland only larger amounts of manure give a good yield of nitrogen, smaller amounts, even if repeated several times, give comparatively high losses of the nitrogen by evaporation.

(2) When using large amounts of liquid manure large amounts of lime also reach the soil, but these can only be utilised if at the same time large quantities of phosphatic manure are supplied.

(3) Large amounts of liquid manure produce a lime-deficient fodder, and this unfavourable action of the manure can be counteracted by a heavy application of lime.

(4) Liming of the soil brings about both an improvement in the quality of the fodder and an increase in the crop.

(5) Potassium phosphate manuring alone, resulted always in diminished crop, but potassium phosphate and liquid manure gave an increased yield.

(6) Each addition of fertiliser brings about a simplification in the botanical constituents, the clover varieties are repressed, but the albumin content of the fodder does not suffer.

(7 Fertiliser conditions or weathering conditions influence the water content of the grass but little ; the grass has the lowest water content on unfertilised plots.

(8) Non-nitrogenous fertilisers give a grass of better quality, but nitrogen containing fertilisers give a much heavier crop. The profits from nitrogenous manuring are considerable.

(9) If it is not possible to apply a nitrogenous fertiliser, a high nitrogen crop can be obtained by a simple potassium phosphate manuring. In these experiments the crop per hectare per year was 40-200 kg. on non-limed plots and 70-230 kg. on limed plots.

GESSNER.

The Influence of Climate and Soil on Plant Life.

LUNDEGARDH, A. Klima und Boden in ihrer Wirkung auf das Pflanzenleben. 113 figures and 2 charts, pp. 319. Publisher Gustav Fischer, Jena, 1925.

This book originated from a series of lectures delivered by the author in the winter 1923-24 at the University of Brünn. It gives an exhaustive review of the Science of ecology and of causal plant geography, and described the author's investigations and the results of experimental work carried out at the ecological station "Hallands Vädero" (Sweden) established by the author. The various problems are studied from a physiological standpoint, and the author attempts to formulate certain general physiological laws, especially the law of the relativity of factor action.

It is impossible to render full justice to this exhaustive book in a short space. After a historical introduction the principal chapters deal with the factors of light, temperature, water, the soil according to its structure and general ecological properties, the physical character and the ventilation of the soil, the chemical factors of the soil, the microorganisms of the soil, the carbonic-acid factor, the main principle of experimental ecological investigation. Each one of these chapters is subdivided into a large number of sections.

The criticism of a scientific work, like the present, cannot and must not have for its object the picking out, from the whole mass of material, of one or other view of the author with which one does not agree; on the contrary such a work must be looked upon as a whole. Taking that view, it may be concluded that this is a work of great scientific value, which should not be missing from the library of any soil-science, geographical, botanical or other Institute. The whole book, and also the illustrations and figures are excellent.

SCHUCHT.

The Afforestation of Calcareous Soils especially by the Speckled Alder and the Black Spruce, in the Forest District of Göttingen.

STASSEN and BEIJRISCH. Uber Aufforstungen ueber Kalködland. *Zeitchrift für Forst- und Jagdwesen.* Year 57. pp. 483-494.

From the chemical part of the paper, particularly from the data relating to the hydrochloric acid soil extracts, the following conclusion can be drawn that, the soils covered by the speckled alder are much richer in nitrogen than those covered by the black spruce. These results probably have some relation to the well known fact of the enrichement of the alders in nitrogen by nodule bacteria, and it is of interest to have some quantitative results. Amongst the nitrogen data given are the following:

Nitrogen content.

Rock	Bare land	Covered by black spruce	Covered by speckled alder
Muschelkalk 0.020	5 cm. depth 0.103 5-20 cm. depth 0.037	5 cm. depth 0.167 5-20 cm. depth 0.092	5 cm. depth 0.345 5-20 cm. depth 0.178

GROSSKOPF.

The Fertility of the Soil in Relation to Soil Acidity.

VITINS, J. (WITYN, J.), Riga, 1924, pp. 80. (Latvian).

The author discusses the importance in the growth of plants, of the factors, air, water and mineral foodstuffs. As a result of numerous investigations he concludes that these factors by changing the reaction character of the soil from neutral to acid, impair the growth conditions of the plant. Thus, e. g. the minimum water capacity (KOSSOWITSCH) of "podsol" upper layers is much smaller than the minimum water capacity of the lower layers. The minimum water capacity of very fine grained "*Gleys*" was only 30 %, while the minimum water capacity of the very loose marl was, in one case, as high as 46 %. Also, the capillary water rise in podsol layers is smaller even than the rise in the case of the very finely grained marl-loams. Plants suffer from a water shortage mostly when growing on podsol soils, when the latter become acidic. The acid reaction of the soil injures particularly the ability of the plant to utilise phosphoric acid and nitrogen, as GEDROIZ proved again and again in his plant experiments. Numerous field experiments show that the Latvian soils contain only minimum quantities of phosphoric acid and nitrogen and the main cause is the lime shorttage. The acid soils contain larger quantities of difficultly decomposable organic substances andof phosphoric acid than those soils, which, formerly strongly acid lost their acidity through cultivation. The author mentions several very fertile soils which at present contain only 0.03-0.05 % of P_2O_5 and which without any phosphoric acid fertiliser whatsoever give very high yields, although the very same soils were previously strongly acid. In the acid soils the P_2O_5 content is 0.1-0.2 %.

The K_2O absorption also is impaired in acid soils, as can be seen best in the so called "*Gley*" soils rich in lime. In the case of these soils also, cases are known in which liming causes an improved utilisation of potassium (as determined by the grain weight without lime fertiliser).

The author mentions gypsum as the cheapest source of sulphur. It is probable that podsol soils suffer from a sulphur deficiency, since cases are known where superphosphate fertilisers gave much better results than basic slag, although the investigated soils belonged to that type on which crude phosphates act very beneficiently.

In the opinion of the author the so-called "active" acidity can impair the growth of a plant only to a very slight extent and only when it is growing on a light, lime-deficient soil. The lime content of heavy soils and of low moors is relatively high and hence their active acidity cannot be very high (buffer action). However, on these soils the roots of plants suffer from a nitrogen deficiency, even when the soil shows a low acidity. The author concludes that the yield from a plant is not determined by the abundance of food material in the soil, but by the physical and chemical properties of the soil. The same conditions determine the amounts of fertilisers required. To secure better crops from poor soils special attention must be paid to liming. By diminishing acidity of these poor soils and even with the same quantities of fertilisers the crops can be increased from two to five times.

L. FREY.

The Decline in Growth of Pines in the Middle and Lower Levels of the State Forests of Saxony.

WIEDEMANN. E. Zuwachsrückgang und Wachstumsstockung der Fichte in den mittleren und unteren Höhenlagen der sächsischen Staakforsten. Akademische Buchhandlung W. Laux. Tharandt, 1925.

The book is subdivided into three main sections and deals with the causes of the decline in growth of the pine, its relation to weathering, and finally with the means to overcome the stoppage of growth. The bock is subdivided into the following sections:

A. The causes of the growth decline in the Saxonian pine forests.

(1) The proof of a growth decline; (2) the growth stoppage in the investigated region; (3) climatic causes of the growth decline; (4) changes in the soil conditions and the humus layer; (5) other injurious causes.

B. Single investigations. (1) The sensitiveness to dryness of other wood varieties; (2) The growth of pines in the period 1911-22, and weathering.

C. The experiments in Saxony on overcoming the decline in growth of pines. (1) General. (2) Precautions taken by the felling authorities in Saxony. (3) Other curative measures. Conclusions.

L. G

Regional Soil Science.

Analyses of Soil Types of Troup County.

Bulletin of the Georgia State College of Agriculture, Vol. IV, No. 2, pp. 28. Athens. Georgia, 1915.

The soils of Troup County belong wholly to the Piedmont Plateau. The following types of soils occur: sandy loams of the Durham, Congaree and Cecil series, and loams and clays of the Cecil, Louisa, Irdell, Congaree and Altavista series. Food material and acid analyses were made of all soils.

HELLMERS.

Analyses of Soils of Dougerthy County.

Bulletin of the Georgia State College of Agriculture, Vol. 5, No. 17, pp. 37, 3 illustrations. Athens, Georgia. 1919.

Dougerthy County lies wholly in the coastal plain. Only a narrow strip in the East belongs to the Grey Sandy Loam division and the rest belongs to the Red Belt. The soil is composed of the gravel and sandy loams of the Greenville, Orangeburg, Tifton, Norfolk, Sesquehanna, Grady, Cahaba and Thompson series, of the sands of the Norfolk series and of the clays of the Greenville and Grady series. In addition are found large swamps, especially along the Coolewahee river and the Chickasawhackee river. The soils of these swamps are coloured black by large masses of organic matter to a depth of 9-12 inches. In appended tables are given the results of food material analyses of all soils.

HELLMERS.

Analyses of Soils of Polk County.

Bulletin of the Georgia State College of Agriculture, Vol. 5, No. 18 pp. 55, figs. 5. Athens, Georgia, 1924.

The greater part of the soil of the Polk County belongs scientifically to the limestone valleys of the north-west of Georgia, a small part in the East belongs to the Appalachian's and a part in the South to the Piedmont-Plateau. Among its soils the Talladega series are represented by shale, gravel and clay limes, the Louisa series by gravel and fine sandy loams, the York series by loam, the Decatur series by clay and stoney loams, the Hagerstown series by gravel, fine sandy and ordinary loam, the Clarcksville series by stoney, gravel and ordinary loam, the Colbert series by fine sandy loam, and the Christian, Arnuchee, De Kalb, Hanceville, Elk, Holston, Huntington and Gongaree series by gravel, stoney and sandy loams. In appended tables are given the results of plant food material analyses of these soils, together with the results of acid analyses.

HELLMERS.

Analyses of Soil of Jasper County.

Bulletin of the Georgia State College of Agriculture, Vol. 7, No. 6, pp. 46, plates 3. Athens, Georgia, 1918.

The soils of the Jasper county belong wholly to the Piedmont Plateau type. Among the soils are represented the Davidson series by loam, the Cecil series by stoney-sandy loam, sandy loam and sandy-clay loam, the Durham, Appling and Wilkes series by sandy loam, the De Kalb series by stony-sandy loam, the Louisa series by clay loam, the Molena series by sandy loam and the Congaree series by fine sandy loam and slimy-clay loam. All soils were examined for plant food material content and acidity.

HELLMERS.

Analyses of Soils of Crisp County.

Bulletin of the Georgia State College of Agriculture, Vol. 8, No. 3, pp. 30, 1 map. plates 3. Athens, Georgia, 1919.

Crisp County belongs wholly to the coastal plain. The main part of its soil belong to Grey Sandy Loam, a sub-division of the coastal plain, and only a narrow strip in the West belongs to the Red Belt. The Norfolk and the Tifton series are represented by sand and sandy loam, and the Greenville and Orangeburg series are represented by sandy loam. The Auston series is represented by loamy sand and sandy loam, the Sesquehanna, Plummer and Grady series are represented by sandy loam, the Kalmia and Myatt series by fine sandy loam and the Congaree series by silt loam. Appended tables give the potash, phosphoric acid, nitrogen and-lime content of these soils as well as the results of acid analyses. HELLMERS.

Analyses of Soils of Pierce County.

Bulletin of the Georgia State College of Agriculture, Vol. IX, No. 9, pp. 36, 1 map, 3 plates. Athens, Georgia, 1921.

Pierce County lies wholly in the region of soils of the coastal plain. The soils in the north-west belong to the Grey Sandy Loams type, the remaining soils belong to the "Flatwood" type. Sands are found in the Norfolk, Plummer, Blanton and Leon series and sandy loams in the above mentioned series and also in the Myatt, Kalmia, Susquehanna and Tifton series. Besides these soils large tracts of the County are occupied by swamps, especially along the rivers. Appended are the results of food material and acidity analyses of all soils except the swamps.
HELLMERS.

Analyses of Soils of Wilkes County.

Bulletin of the Georgia State College of Agriculture, Vol. IX, No. 10, pp. 39. plates 2. Athens, Georgia, 1920.

All soils of the Wilkes County belong to the Piedmont Plateau type. The Cecil series is represented by sandy and stonsy loams and clays. the Appling series is represented by sandy loams and the Congaree series by sandy and clay loams. All soils were analysed as to their potash, phosphoric acid, nitrogen and lime contents and also a determination of the acidity of each soil was carried out. HELLMERS.

Analyses of Soils of Floyd County.

Bulletin of the Georgia State College of Agriculture, Vol. XI, No. 15, pp. 70, Athens, Georgia, 1923.

Floyd County lies wholly in the region of limestone valleys. The soil consists mainly of loams. Clay loams are represented by the Decatur, Hagerstown, Frederick, Christian, Monterallo, Greenville and

Cumberland series, while gravel and stony loams are represented by the Huntington, Jefferson, Allen, Norfolk, Greenville, Hanceville, De Kalb, Shackelton, Monterallo, Frederick and Clarcksville series. Fine sandy loams are found in almost every one of the above mentioned series. In the northerly and north-westerly parts are found in addition pure stony soils. Appended are results of plant food material analyses of all the above soils.

HELLMERS.

Analyses of Soils of Burke County.

Bulletin of the Georgia State College of Agriculture, Vol. XIII, No. 5, pp. 59. 1 map, 2 plates. Athens, Georgia, 1924.

The soil of Burke County in its greater part belongs geologically to the coastal plain. Only the most northerly point belongs to the Piedmont Plateau. The soils of the coastal plain are in the north, the Red Belt soils and in the South Grey Sandy Loams. The varieties of sands found belong to the Norfolk, Austen and Kalmia series, while the sandy loams are represented by the above mentioned three series, together with the Tipton, Orangeburg, Greenville, Susquehanna, Grady, Kalmia, Leaf and Myatt series. A fine sandy loam of the Congaree series is also found. Along th rivers and brooks are found swamps. A series of tables gives the results of food material analyses of the above soils.

HELLMERS.

The Upper Rock Strata of White-Russia.

AFANASIEW, J. *Mem. de l'Institut agronomique à Gorky*, Vol. II, pp. 140-154. Gorky, 1924.

General survey of the rock strata:

(1) Upper beds composed of different types of rocks: siliceous or non-siliceous sands (1 metre), loamy sand (Latvia) — 1 metre; coarse-sandy loam (1 metre); loess-sandy loam (30 cms.-1 metre); loess (10 metres); loams free of siliceous material (up to 0.5 metre).

(2) Middle bed: Sand, free from pebbles, coarsely stratified (from 10 cms.-1 metre).

(3) Lower bed: Moraines, the upper layers of which are usually an accumulation of siliceous detritus; in loess regions, however, they contain humus (0.5-1 metre). In the latitude of Gorky there are found two horizontal strata of moraines, but in the neighbourhood of Wilabsk there are three strata, separated from each other by layers of sand (12-15 metres thick).

The soil forming layers consists of alluvium which overlies the moraines. From these alluvium deposits depend the different horizontal layers, the properties of the different soil varieties and the division into principal agricultural regions.

All strata overlying the moraines are regarded as products separated from the moraines by the glacier waters of the regions.

Evidently the glacier streams, like the rivers of the present day,

separated out the material and deposited and accumulated it on the extensive and very varied moraine beds, adjusting themselves naturally to the topographic and hypsometric conditions of that time.

However, to get a clear picture of the whole process of deposition we must take into account the various, chronologically separated, rock beds of the different periods, as they correspond to the separate and consequent stages of the glacial period. In this respect we can distinguish the following important stages:

After the deposition of the upper layers of the moraines there followed in the latitude of Gorky, just as on the high plateau, a stationary period with predominating damp conditions. Then there were formed on the upper surface of the moraines, humus containing swampy soils, and in the low lands between them peaty masses. In lower lying districts no traces of this stage have been preserved.

Next followed a general rock forming period, the so-called alluvial-sea period, when a certain amount of rock was deposited; on higher lying flat parts loess and sandy soils of a loess character and in lower lying areas, sandy pebble varieties.

The next period is connected with the appearance of the last ice-period, which ended in the north-westerly parts of White-Russia and left behind beds of end-moraines together with the accompanying deposits. The other parts of White-Russia were at the same period subject to the action of glacier water. This action was of a twofold character, both erosive and accumulative.

The last of the retreating ice-masses have left behind traces, particularly on lower lying parts, of sandy strips of old alluvium.

The beginning of the agricultural period, when sands in the form of hills and dunes appeared, has been characterised by the wearing away and consequent removal of the sandy deposits. In regions with soils of a fine-grained character, however, especially in those with soils of a loess type the erosion processes have been continued even to the present time. AUTHOR.

The Soil Division of South-Eastern Russia.

GLINKA, K. (Rostov-on-the-Don), pp. 1-7, 1924.

The author subdivides south-eastern Russia into the following regions:

(1) The region of *ordinary* black-earths (the northern part of the Don territory and perhaps the south-western parts of the District of Stavropol).

(2) The region of *southern* black-earths (the middle parts of the Don territory and the north-eastern parts of the District of Stavropol).

(3) The region of the *Azov* and of the *Lower Caucasian* black-earths (the south-western parts of the Don territory, the main parts of the Kuban territory, a large part of the District of Stavropol and part of the Terskaya territory).

(4) The region of *chestnut coloured* soils (the south-eastern parts

of the Don territory, the northern and the middle parts of the District of Astrakhan and the Government of Stavropol near Matysch).

(5) The region of *brown* soils (the limestone quarries of Astrakhan, etc.).

(6) Foothills with podsol soils (lower Caucasus). AUTHOR.

The Soil of the Kirghis Republic.

GLINKA, K. pp. 1-85. Orenburg, 1923.

After a short historical introduction on the data obtained by the scientific soil investigations of the Kirghis Republic, the author gives a description of the soils and characterises, morphologically and chemically the local black-earth, chestnut, coloured soils, Solonetz and Solontschak soils. AUTHOR.

Chemical Characteristics of the Loess of the Former Cherson Province.

KROKOS, W. *Proceedings of the Scientific Research Institute of Odessa*, Vol. I, August-October, No. 10-11, pp. 1-17, 1924.

In the following report are given the humus CO_2 and SiO_2 content of the different loess varieties and of the moraines.

The loess is poor in humus with the exception of the soil surface. Its content varies between tenths and hundredths of one per cent, but sometimes is nil. The fossil soil contains little humus. The first upper layer of fossil soil, contains 10-0.78 %, the second layer 0.33-0.45 %, and the third 0.62 %.

The low humus content is explained by later decomposition processes.

The carbonate levels of the fossil soils show an increasing CO_2 content. Considerable variations are found in the SiO_2 content, from 63.35 % to 84.56 % in the case of the second loess type, which is the most sandy. All loess layers get less and less sandy as the distance increases from the Dnieper. In the same geological section the loess and the moraine cannot be distinguished from each other by the SiO_2 estimation. This indicates a close connection between the loess and the moraine deposits.

Each loess variety is related to the corresponding glacial epoch, and the four loess varieties of the Cherson Government indicate four glaciations on the Russian plain.

The loess of wind-borne origin could not have been formed during the glacial retreat, since the first, or uppermost loess variety is separated from the moraines by a fossil soil. The second loess variety lying underneath the moraine cannot be separated from its fossil soil. The loess may have been formed in the second half of a glaciation period, or during its stationary state, as a result of the deterioration of its fluvo-glacial deposits.

The glaciation of the Dnieper basin was the third, i. e. the last but one, and it led to the formation of the second, more sandy, loess variety.

The first loess variety was formed during the fourth glaciation, i. e. the last, which affected mainly the north-western parts of Russia and did not reach the Ukraine. AUTHOR.

The Characteristics of the Soils of the Provinces of Odessa and Nikolaew (formerly Kerson.).

KROKOS, W. Part I. *District Board of the Experiment Station*, 1922, Section I, pp. 1-38. Odessa, 1923.

The different kinds of loess of the Provinces of Nikolaew and Odessa were studied principally by means of artificial borings and diggings on the plateau and the upper parts of the slopes.

It was thus proved that on the investigated territory four kinds of loess can be distinguished. The first and principal variety is the wind-borne loess. In the region of development of chrystalline minerals sharp fragments of these are found, and on the terraces of the Dniester near the town of Tiraspol are found sharp fragments of Carpathian fine gravel. These facts can be explained by the action of whirlwinds which may have taken place during the deposition of the loess. The second variety is loess with intermediate layers of dune-sands; the third variety is diluvial loess, and the fourth is fresh-water loess containing residues of fresh-water molluscs.

The sections at Voznesensk and Migaewo represent four varieties of loess with three dividing layers of fossil bodies. The different stages of loess reckoned from the top are marked by the letter L. Thus L_1 represents the first loess stage, L_2 the second loess stage, etc. The existing surface layer or the fossil soils are indicated by the letter *a*. Thus the first loess stage with overlying soil is denoted L_{1a}, the second L_{2a} etc. Moraines are denoted by M.

The loess overlying the moraines is separated from the latter by an intermediate layer of fossil soil. This points to the absence of any relationship between the loess and the moraines, and indicates that this region after the disappearance of the glaciers became covered with plants which helped in the formation of the fossil soil, and that only later conditions arose which were favourable to the formation of the loess.

The depth of L_1 is half that of L_2, L_3, L_4, each taken separately, and from this the conclusion, may be drawn that the time taken in its formation was only half that of each of the separate other and older stages.

The fossil soils which separate the different loess varieties have the character of black-earth, while the soil in L_2 shows pale humus soil; the soil in L_2 and in L_3 is coloured deep black and has a much greater thickness. These facts together with a morphological study of the loess show that on the territory of both districts a steppe was formed not later than the period of deposition of L_4 and existed uninterruptedly up to the present times. Judging from the fossil remains the steppe was originally moist (L_{3a}, L_{4a}) and became drier and drier.

At a depth of 2-4 metres the loess becomes chocolate brown and is traversed by yellow veins, branching vertically, which contain concre-

tions, incrustations and small tubes of manganese salts, and it shows a wedge-shaped clearage the surfaces of which have a brilliant almost lacquered appearance.

This chocolate-brown loess has been formed owing to water logging of the lower surfaces of the loess layer, and the subsequent articulation of the district through river-valley and ravine formation, has effected a partial drainage of it (the district) and a considerable lowering of the soil water content.

The investigations of 1920-1921 proved that L_1 of the Odessa District Province were formed in the after-loess period through an inclination of the continent towards the Black Sea. AUTHOR.

The Lime Requirements of Latvian Soils and their External Characteristics.

J. VITIŅŠ (J. WITYN), pp. 88 + 32, illustrated, Riga, 1924 (in Latvian).

The author discusses the importance of liming for plants and soils, the peculiarities of the podsol-forming process on different subsoils and the external characteristics of lime-requirement. The most important characteristics are:

(1) the colour of the soil, (2) the white weathering crust on the primary rocks found in the soil, (3) the texture of the soil, (4) the nature of the organic substances found in the soil, (5) the effects of dung manuring, (6) the nature of the soil section, (7) the cracking and handening of soils on drying, (8) the permeability of the soil to water, (9) rising of water, (10) the drying of the upper layers of the soil, (11) the development of the Leguminoseae and especially of clover, (12) the weeds. The extermination of weeds is particularly difficult on acid soils.

The author treats in greater detail the following liming materials: (1) burnt lime and its preparation in Latvia from dolomite; not suitable for liming and too costly. (2) Spring lime is found in many places (more than 150 are known) among which are some containing 150,000 cubic metres of lime or more. The lime is of 95 % purity and in many cases reaches 99 % purity. In cases where this spring lime is found at higher altitudes it is hardened and transformed into tufaceous limestone; in the lower levels the lime is very loose, very fine grained and can be used without grinding.

(3) Sea-marl contains 50 % $CaCO_3$, but, is seldom found.

(4) Grey marl-loams contain 20-50 % $CaCO_3$ are found on the sea-coast between Windau and Libau.

(5) Light sandy boulder-clay, very common in Northern Latvia on the Devonian sandstones, contains 10-15 % $CaCO_3$, very seldom 20 % $CaCO_3$. The upper layers are lixivated and "podsoled"; found at a depth of 1-1.5 metres

(6) Heavy boulder-clays are only found in the southern and south-eastern parts of Latvia. Theupper layers are "podsoled"; found at a depth of 60-70 cm.a nd contain 15-30 % $CaCO_3$ in the upper surface, and 20 % in the middle and lower levels 4 % $MgCO_3$. The boulder-clays have been subjected to inundation and subsidiary products have been

formed. Among the latter $CaCO_3$ is found only in striated clays and garnet deposits.

(7) Garnet deposits are found only in osars and in isolated round masses. Lime is found only in a coarse form (grains larger than 1 mm.) and may reach sometimes 81 %; the grains of Silurian limestones from Estonia are rounded and polished. Before use the garnet should be ground although it is being used quite successfully without previous grinding.

8) Striated clays. Their thickness reaches in some cases 1-3 metres. They contain 15-36 % $CaCO_3$ and the $CaCO_3$ content is highest in clays with grains of 0.005-0.05 mm. in diameter. In the heavy finely-grained red clays the $CaCO_3$ content reaches only 15 %. The striated clays are found very often over large areas. These striated clays are especially useful in the case of light, sandy soils and pastures, since they contain besides the lime, 2.5-3.0 % of K_2O. Their use on light soils is equivalent to a complete manuring, as the liming helps in the utilisation of the phosphoric acid and nitrogen.

The author gives many examples of the use of the above liming materials; in many cases the liming has been brought about unintentionally while making deeper cultivation.

In conclusion the author mentions cases when liming brings about unfavourable results, when (1) the materials used contain FeS or FeS_2; (2) on account of the small humus-content of the soil very little carbonic acid is evolved so that the $CaCO_3$ cannot be converted into $Ca(HCO_2)_2$; (3) too much marl has been applied to the soil; (4) the soil suffers from a deficiency of other plant foods, mainly sulphur and phosphoric acid; (5) the soil is excessively moist.

The publication contains 32 photographs and 18 figures.

L. Frey.

The Sands and Sandy Soil of Latvia.

J. Vitinš (J. Wityn), pp. 122 + 25 of German text, 50 illustrations, 6 soil sections (coloured) and 1 map. Riga, 1924.

The sand deposits occupy about $^1/_3$ of Latvian territory. The greater part of these deposits was formed during the ice-age, during the retreat of the ice; a part however, was formed at a later period by the depositing action of the rivers. Also the moraine loams of Latvia contain large masses of sand, which was brought about by the admixture of the sands of the Silurian and Devonian formations during the ice-age.

Large masses of sand are found in the neighbourhood of Riga and of Mitau, and where, even at the present time, the three greatest Latvian rivers, the Dvina, the Liv and the "Kurland" Aa, deposit large amounts of sand. Large deposits are found also in the neighbourhood of Windau, on the sea coast and also further inland.

The mechanical composition of the sand is characterised by the presence of a large proportion of grains of 0.05-0.25 mm. size. In some sands about 98 % of the grains are of that size, and in no case is the percentage smaller than 80. Clay particles (0.01 mm.) occur in the sands very seldom and never to a greater proportion than 6-8 %.

The chemical composition of the sands is quite different from that of the Finnish sands or of the sands of the district of St. Petersburg. The Latvian sands were derived from the latter sands. The Latvian Sands are characterised by a much smaller K_2O and Na_2O content; thus the K_2O content of Finnish sands is 2.05 % (FROSTERUS), of the sands of the district of St. Petersburg (WITYN) is 2.61 % and of the Latvian sands is 1.02-1.38 %. The corresponding Na_2O contents are 2.69 %, 1.85 % and 0.20-0.52 %. They do not contain $CaCO_3$, which is explained by the lower resistance of limestone to crushing and grinding forces. The P_2O_5 content of the deeper lying sands is 0.05 %, and only in a single case was 0.0027 % found.

The sandy soils are mostly covered by forests of classes I-V, the central part being of class III, and heaths are found where the growth of forests would be too difficult.

The quality of the forests, as well as the usefuloness of the soil for agriculture is related very closely to the degree and the character of the podsol forming process. The development of the forests is mainly conditioned by the depth of the local rock level; with a rock depth of 30-50 cm. the forest-development is still satisfactory, but with a depth of 5-15 cm. it is very poor. In such cases the roots of pines do not grow to any depth, but develop horizontally. The mother rock contains about 0.4-0.6 % $CaCO_3$ and has a thickness of about 1 cm.

It is not probable that these soils will improve without liming, as the CaO content of the sand and of the subsoil, soluble in hot 10 % hydrochloric acid, is barely 0.01-0.05 %. Even the soils under forests of the first class are strongly "podsoled." The author is of opinion that a slight diminution in the acidity of the soils would have a very beneficial effect on the pines. The solution of this question in practice is of great difficulty, since account has to be taken of the presence in the soil of various organic substances and of the changes undergone by them, as they and their changes influence profondly the acidity of the soil. Probably good results could be obtained by the application of small quantities of $CaCO_3$, in any case by smaller quantities than those used in Jutland for the heath soils (60,000 kgs. $CaCO_3$ per hectare). The author recommends spring lime as the most suitable liming material for forests soils, and striated clay, on account of its large K_2O content, for agricultural soils.

L. FREY.

Nomenclature and Classification.

The Division of Bavaria into Economic Units on the Basis of its Geological and Soil-scientific Conditions.

NIKLAS, H. and POLT, H. Die Einterlung Bayern in Wirtschaftsgebiete auf Grund der geologisch-bodenkundlichen Verhältnisse. *Zeitschrift des Bayerischen statistischen Landesamtes.* Nos. 3 and 4, 1924.

The authors have divided Bavaria, from a geological point of view, into 33 economic units, and these are subdivided into 434 seed-sowing

units. From tables it can be seen how many districts fall into every one of the units, what the average climatic conditions are for each unit and what the current conditions for cultivation in each unit are. Finally they determine for each unit the average crop for five years in the case of the more important varieties. Of primary importance for the work were, the soil map of Bavaria prepared by H, NIKLAS and published by the *Zeitschrift des Bayerischen Statistische Landesamtes*, and the atlas: "*Bayerns Bodenberwitschaftung unter Berücksichtigung der geologischen und klimatischen Verhältnisse*", prepared by the same author and published in 1917 by the "Statistisches Landesamt". NIKLAS.

The Districts of the Department of the Isère.

ROY, H. The district round Grenoble, pp. 501-520. Grenoble, 1925.

I. The alpine district of the Haut-Dauphiné. The crystalline and Liass beds of Oisans and Valbonais carry fertile pastures. Only rye and potatoes are grown at altitudes above 1000 metres.

The districts of Beaumont, Mateysine and triéves are formed of Liass-schists and carboniferous strata, covered more or less by glaciers, but the marl soils are suitable for the cultivation of cereals and fodder. Oats, tares and fodder grasses are especially grown. The extensive, bare plains are occupied by sheep.

The Lower Alps of Villars de Lans and of Grande Chartreuse are composed mainly of calcareous rocks and carry pastures up to an altitude of 1000-1200 metres.

Grésivaudan. A fertile valley of the Isère, is like a well-watered garden.

II. The Outer-Alpine district or Bas-Dauphiné. The height declines from 500 to 200 metres from the Alps in the direction of the Rhône

The Crémière at an altitude of 250-400 metres, is a Jurassic calcareous, glacial plateau; polyculture is being practised.

The Lyon plain with its fluvio-glacial, ferruginous loams, carries only extensive crops.

The cold siliceous, and heavy clay soils at an altitude of 500 metres, are muddy in winter and very dry in the summer and form the animal breeding and forestry districts.

The plateau of Chambarans, from 600 to 700 metres in altitude; is not agricultural, but carries forests and is a breeding district especially of goats and oxen.

The plains of Bièvre and of Valloise, a dry ravine of fine yellow-coloured sandy-clay soil contains enclosing rounded pebbles of the Rhône Alps. Except in the valleys, the yield of wheat and of stock is low, but the quality is exceptionally high.

The marshes of Bourgoin, rich in humus, are partly drained, and grow poplars and industrial crops.

The Balmes are the hills dominating the Rhône and bear Liass and glacial soils and is a fruit growing and dairy district.

The Roussillon terrace, has the same character and is a vine and peach growing district.

The Rhône sands are occupied by market gardening on account of the very rich soil and the climate; altitude 140 metres. The chief crops are of vines, peaches and apricots.

La Voyeraine extends on a fluvio-glacial terrace at a height of 60-70 metres above the Isère. The sandy soils are used particularly for the growing of nuts for export to the United States.

On the Isère the same phenomenon is observed as in many other places, a falling off in the area of arable land and an increasing area given over to pasture, in the humid climate, especially on clay, and sandy clay soils.

The best potatoes are grown in the Alps in Trièves, Valbonnais and Oisans. The slopes exposed to the north as well as the cold soils of a schistose origin are stated to give better seed than the warm soils, such as those of a sandy nature.

PIERRE LARUE.

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General Notices.

Murgoci. — On March 5, 1925, Rumania lost her most renowned geologist and agrogeologist, by the sudden death of Prof. G. MURGOCI, who by his varied and important research work and original ideas placed himself in the front rank of the leaders of science.

GEORGE MUNTEAN MURGOCI was born in 1872 at Braila. His secondary education was received at Braila and Bucharest at which latter place he also attended the University. Originally he studied Mathematics, Physics and Chemistry, and then turned exclusively to the study of the natural sciences. After the completion of his University career he went to Vienna and Munich where, under G. TSCHERMAK, I. BECKE I. V. GROTH and E. WEINSCHENK he devoted himself principally to the study of petrography, and in 1899 at Munich gained the doctorate, with "magna cum laude". Returning to Rumania he joined the Rumanian Geological Institute as a geologist and made

a detailed geological map of the south-eastern Carpathians. His love of the mountains excelled even his scientific enthusiasm for the study of geology, but his great interest in soil problems led to his very successful agrogeological studies.

In 1905 the Rumanian Geological Institute established an agrogeological section of which he was Director. In 1909 he was appointed Professor of Mineralogy, Petrography and Geology at the Technical High-School of Bucharest.

Agrogeology is a science which can be studied with success only if the specialist has the opportunity to travel extensively, so as to be able to know and study on the spot, soil conditions and relations under the most varying climatic conditions. Even at the present time we do not yet possess such a description of the different soil types as would enable us to study regional soil science from books. MURGOCI satisfied these demands to the fullest extent and there are very few scientists who can possibly undertake so many journeys for study. As a student he travelled over a part of Germany and in the next year visited France and England. In 1904 in London, he married Dr. AGNES KELLY, a highly educated lady with whom he had worked under Prof. WEINSCHENK. He leaves two children, a daughter Helene, who is studying medicine, and a son RADU, who a short time ago gained a prize at Cambridge. After marriage he travelled across the United States, and worked under Prof. A. C. LAWSON and Prof. E. W. HILGARD at the Universities of Leland and Berkeley. In the various countries of Europe, he studied and learned the different methods of mapping in use. However, his repeated travels for the purpose of study, to Hungary and Russia, had a decisive influence on his soil-mapping methods, and made hin an adherent of the Russian school. The soil survey map of Rumania which be submitted to the 1st International Agrogeological Congress in 1909 was constructed on general natural-science lines. On it the different soil-types are grouped in zones, which form an uninterrupted continuation of the different Russian soil zones.

The journeys undertaken by us together in 1907 and 1908 in south Russia and Rumania led to the calling together of the first International Agrogeological Congress at Budapest. MURGOCI was one of the four whose efforts brought about the holding of agrogeological congresses (1).

At the 2nd International Agrogeological Congress at Stockolm the *Internationalen Mitteilungen für Bodenkunde* were founded and he was chosen as one of the editors, which honorary position he occupied until the journal ceased to appear. After the war he was one of the first who helped to reestablish the broken relations between the scientists of the different countries, and his efforts brought about the re-establishment of the International Congress.

At the 3rd International Congress he was elected president of the 5th International Commission for Soil Mapping, and devoted himself to this honorary office with great enthusiasm and was the author of the famous "*Memoires de la Cartographie du sol*".

(1) The letter for the assembling of an International Agrogeological Congress was signed by J. NAMOGLIGH, Odessa, G. MURGOCI, Bucharest, O. TREITZ, J. TIMKO, Budadest, Director L. V. LOGGY, at the Congress which took place at Budapest.

PLATE III.

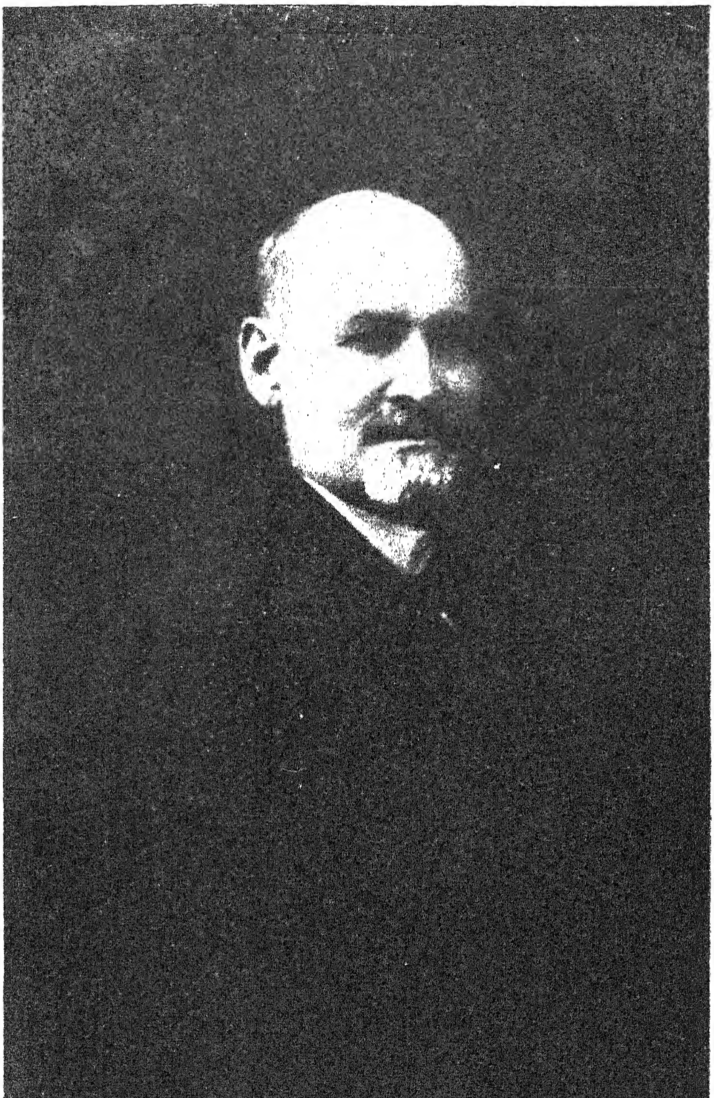

FIG. 13. — MURGOCI. Born at Braila 1872, died at Bucharest May 5, 1925.

Although already ill he devoted all his strength and energy to the edition of the "*Memoires*" and continued this work even during his illness.

He planned several volumes of the "*Memoires*" in which he intended to deal with all the different types of soil and description current in the different countries, but succeeded in publishing only one volume, so that the work was left unfinished. However, even this one volume is of lasting value as an example for future similar work. We also owe to him the first carefully worked out scientific soil nomenclature, which will serve as a basis for future developments.

The 4th International Soil-science Congress decided on the making of a soil-survey map of the whole world. For that purpose a small executive committee was formed of which he was elected Director. And again he put all his energy into the work, hoping to have the work finished before the next Congress. He prepared a sample map as an example. He did not spare his health and his illness was no hindrance to his strenuous work.

In his life, work follows work, with only short intervals for rest and even these were taken only from necessity. However, fate prevented the completion of his great work and early death overtook him in the fullness of his restless activity. His tireless efforts found recognition in his election to membership of numerous scientific societies, among others to the French Academy of Science of Paris. His was one of the best known figures at all the international geological and agrogeological conferences, and owing to his knowledge of languages te always took a prominent part, his opinion in many cases being decisive. Also at the last Soil-Science Congress at Rome, in 1924, he, as Chairman, although in pain, led the discussions. We all known how, owing to his co-operation and to his able chairmanship, that Congress concluded with such valuable results.

It will be difficult to replace this dear colleague whose restless activity exerted such a profound influence on our science and which won him the respect of all who could appreciate it.

He will never be forgotten by those who knew him and his work will have a lasting value.

PETER TREITZ.

Prof. Ramann, President of the Soil Science Research Institute, died at Munich on the 19th of January 1926. An obituary notice will be published in the next number of this *Review*.

Communication of the Executive Committee. — As appears from the list of members published in this number the membership is now 671. This obviously involves a heavy claim on the time of the General Secretary, who is also the Treasurer. I wish therefore to repeat my appeal to members for their collaboration. Members can effectually lighten my work if they will reply at once to my enquiries whether made by letter or circular, and especially if they will send annual subscriptions without delay and, if possible in Dutch florins. enclosing the entrance fee if payable. Remittances should be sent by Post Office, Order or by payment to the "Geldersche Credit Vereeniging", Groningen (Holland), on account ot the International Society of Soil Science.

But as I already suggested in the previous number (Vol. III, No. 3, p. 759), it is absolutely necessary that part of my work be undertaken by the National Sections. I therefore desire to urge members once more to found National Sections and to report to me the composition of the executive committees. My idea is that the secretaries (or the treasurers) of these National Sections should in future assist me by being responsible for receiving new applications for membership, payment of annual subscriptions, the change of addresses, etc., reporting to me on these points and sending me the annual subscriptions in a single account.

Moreover I should like to remind the members that:

(1) The annual subscription for 1926 has been fixed at 6.50 Dutch florins (10 Dutch florins = about 4 Dollars).

(2) The entrance fee for new members amounts to 2.50 Dutch florins (= 1 American Dollar).

Members are requested to send the annual subcription for 1926 before 1 April 1926, with the entrance fee payable.

(3) New members for 1926 who wish to obtain the four numbers of the first volume (1925) of our Journal, must apply to Dr. Borghesani, International Institute of Agriculture, Villa Umberto I, Rome.

(4) In this number, the list of members has been inserted. Kindly inform me in *typescript* of any errors.

(6) The Journal appears in 5 languages; members are asked to inform me, if necessary, in which of these 5 languages they desire to receive the Journal.

(6) In Vol. III, No. 2, the rules of the Society were given. Reprints may be obtained or application to myself.

(7) Members intending to join one or several commissions, are requested to apply at once to the chairmen of the respective commissions. As to the composition of these commissions, see Vol. III No. 2 (April-June 1925).

(8) Members who wish to receive the Proceedings of the Fourth International Soil Science Conference (Rome, May 1924) at the reduced price of 6 American Dollars in accordance with the new arrangements for 1926, are asked to let me know, without, however, sending the money. The sums already sent by a considerable number of members have been forwarded to the International Institute of Agriculture, Villa Umberto I, Rome (Italy).

(9) Finally, I must ask members to be so good as to write in German, English, French or Dutch., I regret that I am not acquainted with Italian and Spanish.

A communication has just reached me from the President Dr. J. G. Lipman, to the effect that, the Organising Committee for the first International Soil Science Congress has resolved that this Congress shall be held at Washington at the beginning of June 1927. Further details will be in future communicated by the American Organising Committee.

Groningen, December 1925.

Dr. D. J. HISSINK,
Acting First Presiden t
and General Secretary.

IV International Soil Science Conference, Rome. — The Organisation Committee met, with Prof. G. de Angelis d'Ossat in the chair, on 30 December in Rome, to discuss the subject of the publication of the "Proceedings". The first volume will be issued shortly by the International Institute of Agriculture, which has undertaken the publication; the other two volumes will follow. The Committee fully recognise and appreciate the interest shown by the President, the General Secretary, Count R. Perotti and the active co-operation of the Bureau of Agricultural Science of the International Institute of Agriculture, as regards the publication of these "Proceedings".

List of Members of the International Society of Soil Science.

(Dated 1 January, 1926).

The countries are arranged in the French alphabetical order; the addresses are, as far as possible, quoted in the original language. The Colonies follow in each case immediately after the mother country. Under the separate countries, libraries are shown first, then institutions, societies, etc., and last of all, names of individuals; each of these groups is arranged alphabetically.

Germany.

Bibliothek der Landwirtschaftlichen Hochschule. Invalidenstrasse 42. Berlin, N. 4.

Bibliothek der Landwirtschaftlichen Institute der Universität. Ludwig Wuchererstr. 2. Halle a/Saale.

Bibliothek der Technischen Hochschule. München.

Bibliothek der Universität. Universitätsstr. 25. Marburg a/Lahn.

Bibliothek des Deutschen Kalisyndikates, G. m. b. H. Dessauerstrasse 28-29. Berlin, S. W.

Bücherei der Biologischen Reichsanstalt für Land- und Forstwirtschaft, Berlin. Dahlem.

Bücherei der Forstlichen Hochschule. Tharandt. (Freistaat Sachsen).

Staats- und Universitäts-Bibliothek. Breslau.

Universitätsbibliothek. Kiel.

Universitätsbibliothek. Beethovenstrasse, 6. Leipzig.

Universitätsbibliothek. München.

Agrikulturchemisches Institut der Hochschule für Landwirtschaft und Brauerei (Direktor: Prof. Dr. H. Niklas). Weihenstephan bei München.

Agrik. Chem. Kontrollstation. Karlstrasse 10. Halle (Saale).

Agrikulturchemische Versuchsstation der Landwirtschaftskammer für die Prov. Schleswig-Holstein. (Vorsteher: Dr. Sieden). Kronshagener Weg 3, Kiel.

Badische Geologische Landesanstalt. Eisenbahnstr. 62a. Freiburg i. Baden.

Bayerische Biologische Versuchsanstalt für Fischerei. Veterinärstrasse 6. München.

Deutsches Kalysindikat G. m. b. H. (Agrikultur-Abteilung). Dessauerstrasse 28-29. Berlin, S. W. 11.

Geologische Landesuntersuchung des Bayer. Oberbergamtes. München.

Geologisches palaeontologisches Institut der Universität. Talstrasse 35. III. Leipzig.

Hessische Geologische Landesanstalt. Darmstadt.

Institut für Geologie der Landwirtschaftlichen Hochschule. Invalidenstrasse 42. Berlin, N. 4.

Kulturtechnisches Institut der Universität. Tragh. Kirchenstr. 74. Königsberg i. Pr.

Landwirtschaftliche Hochschule. Meckenheimer Allee 102. Bonn-Poppelsdorf.

Landwirtschaftliche Versuchsstation. Hornerweg 104. Hamburg. Horn.

Landwirtschaftliche Versuchsstation Limburgerhof der Badischen Anilin- und Soda Fabrik. Mutterstadt II. (Rheinpfalz).

Mineralogisch-Geologisches Institut der Technischen Hochschule. Neptunstrasse 14. Danzig-Langfuhr.

Preussische Geologische Landesanstalt. Invalidenstrasse 44. Berlin, N. 4.

Preussische Moor-Versuchsstation. Neustadtswall. Bremen.

Sächsisches Geologisches Landesamt. Talstrasse 35. Leipzig.

Staatliche Landwirtschaftliche Versuchsanstalt. (Direktor: Prof. Dr. NEUBAUER). Stübel-Allee 2. Dresden, A.

Stickstoff-Syndikat G. m. b. H. Neustädtlische Kirchenstrasse. Berlin, N. W. 7.

Untersuchungsamt der Landw. Kammer in Königsberg i. Pr. Königsberg.

ALBERT, Prof. Dr. R. Forstakademie. Brummstr. 10. Eberswalde.

BLANCK, Prof. Dr. Agrikulturchemisches Institut. Nikolausburgerweg 7. Göttingen.

BÖHM, Prof. Dr. A. Enzianstrasse 1. Berlin. Lichterfelde.

BÜLOW, Dr. Kurt von. Preussische Geologische Landesanstalt. Invalidenstrasse 14. Berlin.

BUNGERT, Dr. I. Oberförster. Kaiser-Friedrich-Ring 82. Wiesbaden.

DENSCH, Prof. Dr. Alfred. Direktor des Institutes für Bodenkunde und Pflanzenernährung der Preuss. Landwirtschaftlichen Versuchs- und Forschungsanstalten. Theaterstrasse 25. Landsberg a. W.

EHRENBERG, Prof. Dr. Paul. Hansastrasse 24. Breslau.

FAUSER, Oberbaurat Otto. (Ministerium des Innern.). Sporerstrasse 5. Stuttgart.

FISCHER, Dr. Hermann. Herzogstrasse 58 III. München.

GANSSEN, Prof. Dr. R. Königsallee 9. Berlin-Grünewald.

GEHRING, Dr. A. Landw. Versuchsstation. Braunschweig.

GÖRBING, Johannes. Dipl. Nahrungsmittelchemiker, Laboratorium für Bodenkunde und Pflanzenernährung. Borsteler-Chaussée 128. I. Hamburg, Grossborstel.

GÖRZ, Dr. R. Diplomierter Landwirt. Jagowstrasse 19. Berlin-Grünewald.

HALLER, Chemiker Dr. Hans. (Geologische Landesanstalt). Invalidenstrasse 44. Berlin, N. 4.

HÄRTEL, Dr. Fritz. (Geologe). Talstrasse 35. Leipzig.

HARRASSOWITZ, Prof. Dr. Hermann. O. Prof. der Geologie und Paleontologie, Direktor des geologischen Instituts der Universität Giessen. Ludwigstrasse 23. Giessen.

HELBIG, Prof. Dr. M. Freiburg (Breisgau).

HELLMERS, Dr. Hans. (Institut für Geologie). Invalidenstrasse 42. Berlin, N. 4.

HOHENSTEIN, Dr. Viktor. Neustädtische Kirchstrasse 9. Berlin, N. W. 7.

KRAUSS, Dr. G. Privatdozent der Bodenkunde an der Universität München. Amalienstrasse 52-0. München.

KRÜGER, Prof. Dr. h. c. E. Geheimer Regierungsrat. Alleestrasse 1. Hannover.

KUHSE, F. Technische Hochschule, Geologisches Institut. Danzig. Langfuhr.

LANG, Prof. Dr. Richard. Universitätsprofessor. Wilhelmstrasse 7. Halle a. d. Saale.

LEMMERMANN, Prof. Dr. O. Direktor des Institutes für Agrikulturchemie und Bakteriologie der Landwirtschaftlichen Hochschule. Albrecht-Thaerweg 1. Berlin. Dahlen.

MACH, Prof. Dr. F. Landwirtschaftliche Versuchsanstalt. Post Grötzingen i. B. Augustenburg.

MEYER, Dr. Diedrich, Direktor der Landw. Chem. Untersuchungsanstalten der Landwirtschaftskammer Schlesien. Matthiasplatz 6. Breslau.

MITSCHERLICH, Prof. Dr. E. A. Pflanzenbau-Institut der Universität. Tragheimer Kirchenstrasse 83. Königsberg i. Pr.

MÜNICHSDORFER, Dr. F. Landesgeologe. Ludwigstrasse 14. München.

NELLZENBRECHER, Dr. R. Rudmannstrasse 16. Salzwedel.

PFEIFFER, Prof. Dr. H. Geologische Landesanstalt. Invalidenstrasse 44. Berlin, N. 4.

PUCHNER, Prof. Dr. H. Landwirtschatliche Hochschule. Weihenstephan bei München.

RAMANN, Prof. Dr. E. Amalienstrasse 52. München.

REIHLING, Dr. rer. nat. Karl, Regierungsrat, Vorstand der Bodenkundlichen Abteilung der Württembergischen Forstlichen Versuchsanstalt. Arminstrasse 6. Stuttgart.

SCHNARRENBERGER, Dr. Carl. Landesgeologe. Badische Geologische Landesanstalt. Eisenbahnstr. 62 a. Freiburg i. Baden.

SCHUCHT, Prof. Dr. F. Güntzelstrasse 59. Berlin. Wilmersdorf.

STREMME, Prof. Dr. H. Mineralogisch-Geologisches Institut der Technischen Hochschule. Neptunstrasse 14. Danzig, Langfuhr.

TRÉNEL, Chemiker Dr. M. Geologische Landesanstalt. Invalidenstrasse 44. Berlin, N. 4.

UTESCHER, Chemiker Dr. K. Hasenmarkt 23. Spandau bei Berlin.

VAGELER, Dr. Pflanzenzuchtstation der Landwirtschaftskammer für die Provinz Ostpreussen. Ramten, Ostpreussen.

VATER, Prof. Dr. Dr. h. c. H. Geh. Forstrat. Tharandt.

WIESSMANN, Dr. Hans, Privatdozent. Werftstrasse 18. Berlin N. W. 52.

WOLFF, Prof. Dr. W. Abt. Direktor Geologische Landesanstalt. Invalidenstrasse, 44. Berlin, N. 4.
ZUNKER, Prof. Dr. Ing. F. Direktor des Kulturchemischen Institutes. Hansastrasse 25. Breslau, 116.

Austria.

Bodenkundliches Laboratorium des Landes-Meliorationsamtes. Vertreter Dr. Ing. Bernhard RAMSAUER, Landespedologe. Müllnerhauptstrasse 54. Salzburg.
LEININGEN - WESTERBERG, Dr. Wilh. Graf zu. Lehrkanzel für forstliche Bodenkunde und forstliche chemische Technologie an der Hochschule für Bodenkultur. Hochschulstrasse 17. Wien, XVIII.
STINY, Prof. Dr. J. Höhere Forstlehranstalt. Bruck a. d. Mur.
TILL Prof. Dr. Alfred. Lehrkanzel für landwirtschaftliche Bodenkunde an der Hochschule für Bodenkultur. Piaristengasse 62. Wien.

Belgium.

Comptoir Belge du Sulfate d'ammoniaque. Société Anonyme. Rue Berckmans 8. Bruxelles.
SIMOENS, W. Staatslandbouwkundige. Poperinghe. West-Vlaanderen.
SYS, Maurice. Staatslandbouwkundige. Dixmuiden. West-Vlaanderen.

Cuba.

ANDERSON, E. L. Cuban Sugar Club. Apartado 1973. Habana.
FORTUN, Ir. Gonzalo M. Ingeniero Agrónomo, Director Estación Experimental Agronómico de Cuba. Santiago de las Vegas.
RAPALJE, E. H. Manager, American Agricultural Chemical Company. 553 Banco Nacional de Cuba. Habana.
THURSTON, F. R. Manager, Central " Oriente ". Oriente.
WALKER, E. S. Superintendent of Agriculture. Central Preston. Preston, Province of Oriente.
ZELL, J. R. Finca " El Conde " Hershey, Province Habana.

Denmark.

Den Kgl. Veterinaer - og Landbohøjskoles. Bibliothek. Bülowsvej 13. København, V.
Afdeling for Landbrugets Plantedyrkning. Den Kgl. Veterinaer - og Landbohøjskoles. (Director: Prof. K. A. BONDORFF og Prof. E. LINHARD. Rolighedsvej 23. København,
Danmarks Geologiske Undersøgelse. (Director: Victor MADSEN). Gammelmønt 14. København, K.
Den Kgl. Veterinaer - og - Landbohøjskoles, plantefysiologiske Laboratorium, (Director: Professor Dr. H. WEIS). København, V.

Det danske Hedeselskab. Viborg.
Det Kgl. danske Landhusholdningsselskab. Vestre Boulevard 34. København, B.
Ladel und Landbrugsskoles Kemiske Laboratorium. Brørup.
Landbrugsraadet. Vestre Boulevard 4. København, B.
Statens Forsøgsstation i (Director: C. IVERSEN). Askov, pr. Vejen.
Statens forstlige Forsøgsvaesen. (Director: Prof. Dr. A. OPPERMANN). Springforbi, ved København.
Statens Havebrugs-Forsøgsstation. (Director: N. ESBJERG). Blangsted, pr. Odense.
Statens Marskforsøg. (Director: C. J. CHRISTENSEN). Ribe.
Statens Planteavls Laboratorium. (Director: CHRISTENSEN, Dr. H. C.) Lyngby.
Statens Plantepatologiske Forsøg. (Director Prof. Dr. C. FERDINANDSEN). Lyngby.

BIILMANN, Prof. Dr. E. Direktor des chemischen Laboratoriums der Universität. København.
LUND, cand. polyt. Augusta Landbohøjskolen. Bülowsvej 13. København, V.
OLSEN, Dr. Phil. Carsten. Carlsberg Laboratorium. København, Valby.
RORDAM, Prof. Dr. K. Landbohøjskoles. Bülowsvej 13. København, V.

Egypt.

ABDEL-VAHID FAHMY, Effendi. Inspecteur au Ministère Egyptien de l'Agriculture. Le Caire.
MOSSÉRI, Victor M. Président de l'Institut d'Egypte. 25, Rue Cheik Aboul-el-Sebaa. Le Caire.

Spain.

Estación Agronómica - Instituto Agrícola de Alfonso XII. Director Ing. Guillermo QUINTANILLA. La Moncloa. Madrid.
ALCARAZ, Excmo Sr. D. Enrique. Ingeniero Agrónomo - Profesor de la Escuela de Ingenieros Agrónomos. Juan de Mena 15, pral. A. Madrid.
ARGÜELLES, Sr. D. Ernesto de Canedo. Ingeniero de Montes y Geógrafo. Director de la Biblioteca del Instituto Geográfico. Villanueva, 43. Madrid.
BILBAO y SEVILLA Ing. Francisco, Délégué de l'Espagne dans l'Institut International d'Agriculture. Villa Umberto I. Roma (10).
DALDA de TORRE, Sr. D. Adolfo Ingeniero de Montes. De la Sección de Montes del Ministerio de Fomento. San Bartolomé 6. Madrid.
H. del VILLAR, Sr. D. Emilio. Lista 62, 3° der. Madrid.
ITURRALDE, Sr. D. Julián. Ingeniero de Montes - Profesor de la Escuela de Ingenieros de Montes. Arenal 8. Madrid.
MARCILLA, Sr. D. Juan. Ingeniero Agrónomo - Profesor de la Escuela de Ingenieros Agrónomos. La Moncloa. Madrid.

MUÑOZ, Sr. D. Juan Diaz. Ingeniero Agrónomo - Profesor de la Escuela de Ingenieros Agrónomos. Rodriguez San Pedro, 29. Madrid.

SANZ, Sr. D. José Lillo. Ingeniero de Montes. Villanueva 43 pral. Madrid.

Esthonia.

Bodenkundliches und Agrikulturchemisches Kabinett. (Leiter: A. NOMMIK). Vene uul. 28. Tartus.

United States.

Library of the Los Baños College F. O. Los Baños, Philippines.

Soil Improvement Committee of the National Fertilizer Association. Insurance Building. Washington, D. C.

AGEE, Director H. P. Director Experiment Station of the Hawaiian Sugar Planters Association. Honolulu, Hawaii.

ALBRECHT, W. A. College of Agriculture. Columbia. Missouri.

ALLEN, H. B. Experiment Station. New Brunswick. New Jersey.

ALLISON, Dr. F. E. Fixed Nitrogen Research Laboratory, Department of Agriculture. Washington, D. C.

ALLISON, Robert V. c/o Cuban Sugar Club. Tropical Plant Research Foundation Central Office, 1350 B Street, Southwest. Washington, D. C.

ALWAY, F. J. University of Minnesota. St. Paul. Minnesota.

ANDERSON, Dr. M. S. Bureau of Soils, United States Department of Agriculture. Washington, D. C.

BALDWIN, Mark. Bureau of Soils, United States Department of Agriculture. Washington, D. C.

BARNES, E. E. Ohio State University Soil Department. Columbus. Ohio.

BARNETTE, R. M. Experiment Station. Gainesville. Florida.

BARRETT, Rollin H. Vermont State School of Agriculture. Randolph Center. Vermont.

BATES, H. R. Manager Manufacturing Department. P. O. Box 1725. Atlanta. Georgia.

BAYLOR, H. B. Sales Manager. P. O. Box 1752. Atlanta. Georgia.

BEARER, E. V. Experiment Station. New-Brunswick. New Jersey.

BECKWITH, Charles, S. Browns Mills. New Jersey.

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PROCEEDINGS OF THE INTERNATIONAL SEED TESTING ASSOCIATION

Papers.

SEED INJURY FROM FUNGI AND INSECTS.

In seed research not only the germinating power, purity and genuineness are of interest, but an important factor also is the sanitary condition. Sometimes, though the germination power is satisfactory, the seed is still not sufficiently sound and so is not fit to be sown. It may be improved by disinfection, but in some cases there is no remedy and the whole lot has to be rejected for sowing purposes.

As to fungous diseases, two different ways may be distinguished in which these can be transferred by the seed: (1) the seed may be infected by spores (e. g. *Tilletia*), (2) mycelium may have penetrated into the seed.

As to the latter, the sanitary condition may be easily verified after the seeds have been in a moist atmosphere for a few days as this permits any existing fungi or bacteria to develop more readily.

Generally the presence of fungous diseases may be easily diagnosed by examining the germinating beds. But the seeds in these beds are somewhat close together, so that there is danger of contact infection. For this reason it is preferable to use open zinc trays (26 cm. × 10.5 cm.), covering the perforated bottom of these trays with moist filter paper and laying a similar cover over the whole. The number of seeds for the test is so limited, that contact infection may in this way be avoided.

Should the seeds not happen to be in good condition owing to their vitality being damaged from some cause, they are less immune against saprophytic fungi. The presence of such fungi, though not itself causing disease, indicates an inferior soundness of the seed. Such saprophytic fungi may be different species of the following genera : — *Penicillium, Aspergillus, Rhizopus, Mucor, Cephalothecium, Oedocephalum, Stysanus, Acrostalagmus, Alternaria, Chaetomium,* and others.

Fungi belonging to the pathogenic group, however, are of more importance and a short summary of these is given as follows.

Peas are often infected by *Ascochyta Pisi.* When the germinating power is ascertained, this fungus is as a rule easily recognized, and the percentage of attack may also be determined. On the dry seeds the infection is often indicated by yellowish spots, which, however, cannot always be determined with certainity, and so in inspecting the seed beds, the infection may prove to be more severe than seemed probable from the infection of the dry seeds.

The severity of the infection varies in different years. The past season (1924) in this respect has been a very bad one in Holland, as may be seen from the following table.

Season	Percentage of Ascochyta attack										
	0 [1]	10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100
	%	%	%	%	%	%	%	%	%	%	%
1920–21	11	40	25	10	7	4	3	0	0	0	0
1921–22	25	42	13	8	2	4	6	0	0	0	0
1922–23	25	67	5	2	0	1	0	0	0	0	0
1923–24	34	41	13	10	0	1	1	0	0	0	0
1924–25	8	33	19	15	8	8	3	3	2	1	0

(1) Percentage of samples examined at Wageningen.

With regard to this fungous infection it seems desirable to fix a limit above which no seed should be considered fit for sowing. Not only the percentage of infected seeds is of interest, but also the severity of attack of each individual seed. If the percentage of infection be a high one, then the degree of individual infection is also sure to be very severe, that is to say most of the seeds will be as a rule badly infected, the cotyledons being penetrated to a marked degree by the fungus. From such a diseased seed there will develop, if anything, a veıy weak seedling, which is likely to perish at an early stage. If the diseased spot be not too large, the plant may grow, but it may then become a source of infection to adjacent plants, if the weather be favourable for the further development of the fungus. The consequence of serious infection is thus twotold: (1) the seedling is abnormal in appearance, (2) diseased plants are produced.

Other fungous infections apparent on peas, are caused by *Macrosporium* sp., *Fusarium* spp., and *Botrytis cinerea.* The exist-

ence of these three fungi may also be determined in relation to germinating power.

In addition to the above, peas may be damaged by *Bruchus pisi* or by *Grapholitha nebritana.* As regards the first, it should be mentioned that in the samples tested at Wageningen, a weevil was rarely present in the infected peas, and as a rule there was only the round hole left by the insect. One series of samples, however, sent for testing this season, appeared seriously attacked, and in this case most of the infected seeds still contained the insect in a more or less developed stage. This series had been imported from another country, with different climatic conditions.

Beans may be infected by *Colletotrichum* (*Gloeosporium*) *Lindemuthianum.* On moist seeds in the seed-bed, the spores are formed freely on bright colored spots with a characteristic dark border. On dry seeds of bright colored species these spots are easily recognised, although less distinct on the brown colored types.

The *Macrosporium* infection is much more common on beans than on peas. The infected dry seeds show a small pink spot just underneath the micropyle. During germination, the spot enlarges considerably and becomes purple with a yellow margin. A greyish mycelium develops with multi-cellular spores. The perithecial stage, *Pleospora,* belonging to this species, though as a rule immature, is also very frequently formed. This infection is often dealt with by various disinfectants, as the fungus is rather superficial. In this way, if the attack is not too serious, normal plants may be produced. The damage may be serious at the early stages of plant growth, but can be checked at the first stage. If the plant outgrows this dangerous period it will not show any symptoms of attack, though the spores may be found later, dispersed on leaves and pods, apparently not causing much harm. It is therefore only if the first stage of development be neglected, that the fungus may become disastrous

In Holland, 1923 was a very bad season as regards quality of beans. During harvest time, the weather had been decidedly moist, and consequently the seeds were exposed to unfavourable conditions before being harvested. No specific disease occurred, but there was a large increase of various saprophytic fungi and bacteria. In many cases, disinfection was effective especially against fungous attacks, compared with bacteria infection.

In connection with disinfection of seeds in general, the follow-

ing observation may be made. Disinfection may favour the health of the seeds before they are brought to the seed beds. It is not, however, advisable, if the germinating power has to be determined, as this mechanical process is liable to alter the condition of the seed. The determination of the germinating power of disinfected seeds may, nevertheless, be a distinct advantage to the sender of sample grains of cereals, beans, beet seeds, etc., as compared with untreated seeds. In this way he is able to get a good idea as to the state of the seeds and at the same time information respecting any possible improvement. In Wageningen, therefore, such tests are made regularly with disinfected seeds.

Beans may also be at acked by weevils. Great losses may be caused by *Bruchus obtectus*. As contrasted with *Bruchus pisi*, this species lays eggs also on the mature seeds, into which the larva bores. In this way the spread of infection in the stored seeds may be accentuated. This form of infection is, however, exceptional in our country.

Also in field beans (*Vicia Faba*), if attacked by *Bruchus* spp., the weevil is often to be found in the seeds. The two species found in this case are: *Bruchus atomarius* (*granarius*) and *B. rufimanus*. Sometimes the weevil appears to be attacked by ichneumons, and a fly instead of a weevil is seen in the hole

Cereals are more especially attacked by *Fusarium* sp. This may readily be detected in the seed-beds. In Holland, particularly oats and wheat are sometimes liable to severe infection. The years 1919 and 1920 were bad *Fusarium* years in this country, but since then the infection has not returned to such an extent. Mycelium and spores, which d'ffer with varius species, develop freely in the humid germinating seed beds. For example, *Fusarium culmorum* is characterized by the chocolate-coloured spores; *F. herbarum* by the salmon colour; *Gibberella Saubinetii* by the purplish brown mycelium and the tendency to form dark bluish perithecia. To be quite sure of the species, a microscopical examination is necessary. In the bad *Fusarium* years, the *G. Saubinetti* was the most widely spread: and secondly *F. culmorum*. In addition to these the following infections may be mentioned: *Claviceps purpurea*, the sclerotia of which are frequently found to be mixed with the grain; fritfly, especially in oats; *Tilletia Tritici* and *T. foetans* on wheat. An indication of this form of infection is firstly the smutted grain and secondly the loose spores. These may best be detected

by soaking about 100 grains in water. The water is then drained off and in order to get a more condensed spore emulsion, the water may be partly evaporated until only a few drops are left, or else a centrifuge may be used followed by microscopical examination, to detect whether the grain is infected by *Tilletia*.

Still other forms of infection may be mentioned, such as *Colletotrichum linicolum* and *Botrytis* sp. on flax seed. The percentage of infection may also be determined. Zinc trays, as described earlier, with moist filter paper at the bottom, may be used also in this case. It has been found practicable to divide the tray into four partitions by means of three glass dividers on which a covering glass plate rests. In this way, the space within is kept moist. About six days after the seeds have been placed in the germinating beds, the *Botrytis* colonies are counted. Infections caused by *Colletotrichum* may be treated in the same way. Treatment with Uspulun dry disinfectant or with Germisan have proved very effective in the control of *Botrytis* infection. These dry disinfectants are easily handled as compared with solutions, which are of course unfit for disinfection of flax seeds.

On beet seeds infection of *Phoma Betae* is verry common and samples which are wholly free from this fungus are scarce. An examination of these seeds at the time of determination of the germinative power, by means of a binocular microscope, has shown the occurrence of *Phoma* pycnidia on the seeds or on the root, and thus it is possible to state the degree of the infection as a percentage. Treatment of the seed with a 50 % Germisan solution for two hours, checks the infection to a considerable extent.

Seeds of prasley and celery may be infected by *Septoria Petroselini* and by *S. Petroselini* var. *Apii*; the pycnidia of these fungi may also be detected by means of a binocular microscope.

Sometimes tree seeds may be damaged by insect pests, as for example in certain samples sent for testing to Wageningen: —

Pseudotsuga Douglasii by *Megastigmus spermotrophus*;
Abies pectinata by *Megastigmus strobilobius*;
Rosa multiflora by *Megastigmus* sp.
Betula alba by *Oligotrophus betulae.*

The above account, though far from being complete, will show the need for a more uniform method of research in these matters.

L. C. Doyer,
Seed Testing Station, Wageningen.

THE DISTINCTION BETWEEN SEEDS OF ITALIAN RYE-GRASS AND PERENNIAL RYE-GRASS AND BETWEEN SEEDS OF RYE-GRASS AND MEADOW FESCUE

Foreword.

Perennial Rye-grass and Italian Rye-grass are two of the most important and most commonly cultivated grasses in Denmark, about 1 600 000 kg. and 800 000 kg. seed of these species respectively being used every year. This represents about 20 and 10 per cent. respectively of our entire consumption of grass and clover seed. These two species are, as is known, somewhat different from each other in respect of permanence, hardiness and adaptability to the soil. Their seeds bear a strong resemblance to each other; those of Italian Rye-grass are certainly partly furnished with awns, but threshed and cleaned lots often contain 50-75 per cent. awnless seeds, the well known and high-yielding Danish strain Tystofte No. 152 especially, containing many such seeds. As is known, seeds of Perennial Rye-grass have generally no awns or, occasionally, very small awns. So far, it has proved impossible to distinguish with certainty between seeds of Perennial Rye-grass and awnless seeds of Italian Rye-grass. Various authors have mentioned that the shape of the teeth on the inner pales are sufficiently characteristic to identify the two Rye-grass species; the difference in this respect, however, frequently does not hold good, so it is inadequate for differentiating with certainty between the two seed species.

At my request, Herr E. HELLBO (agricultural scientist) being employed as scientific assistant at the Danish State Seed Testing Station, has made observations with a view to determining realiable botanical criteria for the species in question.

As Herr HELLBO's researches having reached a stage where it is considered that positive results have been obtained, we have decided, in view of the considerable number of tests made, to record these results; reports on subsequent researches will be published in due course.

Some of the assistants at the Danish State Seed Testing Station are now able to make this determination of the identity of Rye-grass, and from 1st October, 1925, we are prepared to de-

termine, by microscopic examination (1) whether a sample consists of Perennial Rye-grass or of Italian Rye-grass (2), if a sample of Perennial Rye-grass contains seed of Italian Rye-grass, and vice-versa, and (3) the percentage of each of these species in any sample.

K. DORPH-PETERSEN,
Director of the Danish State Seed Testing Station.

I. *Italian Rye-grass and Perennial Rye-grass.*

In the summer of 1922, while making observations in the control fields of the Danish State Seed Testing Station, I noticed for the first time a distinction between Italian Rye-grass and Perennial Rye-grass in the presence or absence of teeth at the marginal nerves of the outer palea, and since then this distinction has been the object of my observations. A provisional account of the results of my investigations is given below.

A short description of those characters of the two species which I have especially examined is given, whereas such differences as refer to the morphology of the seesd, being without interest in this connection, are left out of consideration.

In this report the term " seeds ", as ordinarily used when referring to grasses, denotes the fruit enclosed by the outer and the inner palea.

Seeds of Italian Rye-grass (*Lolium italicum* Braun) are generally oval. The outer palea as a rule bears a long awn, but this characteristic is not always present, even in unthreshed lots. *At that portion of the marginal nerves of the outer palea which is marked* b (*Fig.* 14 *a*) *I have, with the undernoted exceptions, always found from one to many teeth, as a rule comparatively large.* Those portions marked *a* and *c* were also in most cases furnished with teeth. The teeth at the nerves of the inner palea are *most frequently* long and comparatively narrow (O. ROSTRUP). The rachilla is narrower and more cylindrical than that of Perennial Rye-grass.

Seeds of Perennial Rye-grass (*Lolium perenne* L.) often have a somewhat rectangular shape. Only in a few cases is the outer palea furnished with a poorly developed awn. I am inclined to believe that the presence of an awn is often due to crossing

in a far-off generation. *On that portion of the two marginal nerves of the outer palea marked* b *in Fig. 2 teeth have not been observed* (except in the under-mentioned peculiar cases), whereas teeth often occur at the portions marked *a* and *c* (especially at the latter). The teeth at the nerves of the inner palea are, compared with those on Italian Rye-grass, *most frequently* short and broad, and the rachilla is broader, more flattened, and more closely pressed to the inner palea than that of Italian Rye-grass (O. ROSTRUP).

In my observations I have left out of consideration whether the seeds were awned or not, as the object was to discover a method of distinguishing between the two species even if the awns were absent or if they had been broken off by the threshing and the cleaning of the seed. Italian Rye-grass after being threshed and cleaned often contains as much as 40 to 75 per cent. awnless seeds.

Of the authors, whose works have been at my disposal, only one, viz. E. D. HARTZ ("*Landwirtschaftliche Samenkunde*" 1885), has mentioned in this connection teeth at the outer palea, which he describes as "kurz-borstig gewimpert" (bearing short hairs). It is not clear, however, either in the text or in the illustrations in his book, what he means, and he does not appear to attach any great importance to this condition.

Frequently, when I have found teeth on Perennial Rye-grass at the portion marked *c* (Fig. 14 β), they have been somewhat lengthened and bent. Very occasionally, on the *uppermost* seeds in the spikelets of this species, I have observed teeth on the marginal nerves from the end to the middle of the seed. It has always been possible to recognise these "uppermost seeds" from the others on account of their smaller size and their tendency to taper upwards. These "uppermost seeds" very seldom occur in well-cleaned lots as they are generally poorly developed.

The seeds of Italian Rye-grass — as previously mentioned — are furnished with a variable number of teeth at that portion of the marginal nerves of the outer palea that is marked *b* with the exception, however, of, on an average, 5-6 per cent. of the seeds examined.

The majority of the seeds without teeth, however, have been found to be the *lowest seeds* in the spikelet; these as a rule differ in shape from the seeds above them. Such a "lowest seed" is illustrated in Fig. 14 γ; it is characterized by its flat-topped glumes

and its broad rachilla. An awn is generally absent, and very often the glumes contain no fruit, or only a poorly developed one. The greater portion of such seeds is usually removed during cleaning operations. A test of Italian Rye-grass as to genuineness of species, should therefore be made of the " pure seed " of the sample.

Practically all these " lowest seeds " of Italian Rye-grass as

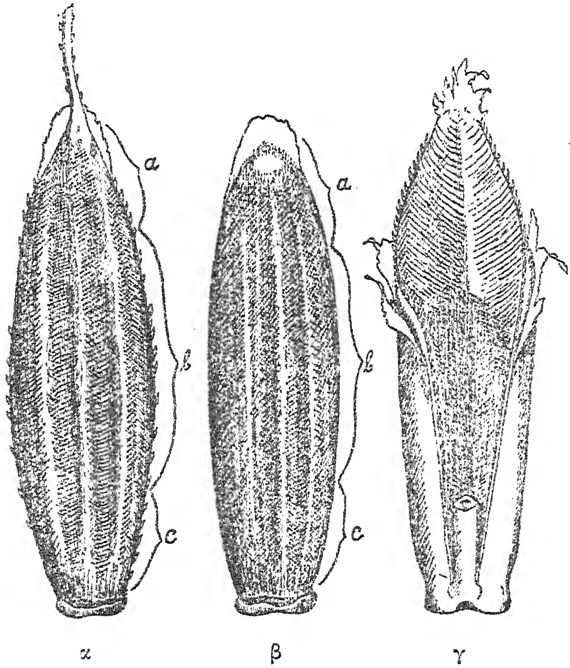

FIG. 14. — α. Italian Rye Grass (*Lolium italicum* Braun).
β. Perennial Rye-Grass (*Lolium perenne*).
γ. Italian Ry-eGrass (*Lolium italicum* Braun).
Lowest seed in spikelet).

well as the few others without teeth on the middle portion of the marginal nerve, had those long teeth on the nerves of the inner palea, which several authors have considered characteristic of the species in question. I shall not enter here into further details with respect to these teeth, which have been somewhat differently described by a number of authors (O. ROSTRUP, A. VOLKART and F. G. STEBLER, S. F. ARMSTRONG, G. LAKON and others). Though the size of the teeth on the inner palea may vary within each of the

two species, yet the charateristic length may be important in determining those seeds of Italian Rye-grass which are not toothed at the middle of the marginal nerves of the outer palea.

WITTMACK, amongst others, mentions that the inner palea of Italian Rye-grass is as long as the outer palea, and that in Perennial Rye-grass the inner palea is shorter than the outer palea, but this rule according to our observations does not appear to hold good in all cases.

Seeds of both species may have teeth on the surface of the outer palea in other places than the marginal nerves. For example, Italian Rye-grass has sometimes (more frequently than Perennial Rye-grass) teeth on the surface between the marginal nerve and the membranous edge of the outer palea. Mention should be made of the fact that in Italian Rye-grass teeth have sometimes been noticed to be present on one of the marginal nerves and absent on the other.

A binocular microscope (magnifying either 33 or 45 times) or a lens (magnifying 16 times) has been used in the observations. The teeth mentioned may most easily be seen in transmitted light when the seed is lying with the back upward on a slide under the microscope, provided that the marginal nerves are situated exactly on the edge of the seed. Unfortunately this is not always the case, and, therefore, some seeds must be held with the fingers under the microscope or before the magnifying glass and at the same time turned round.

An account of the results obtained from the observations carried out is given below:

A. *Italian Rye-grass.*

(1) From each of the 13 different plots in the experiment garden of the Danish State Seed Testing Station, sown with samples of Italian Rye-grass, one typical plant was harvested (7 of the Danish strain Tystofte No. 152, 1 described simply as Danish, 3 Irish, 1 Irish-French, and 1 French); 50 kernels from each of these plants were carefully examined. On an average about 11 per cent. of these seeds lacked teeth at the middle portion of the marginal nerves, but nearly all were recognised as "lowest seed" in the spikelet, and, moreover, were furnished with long teeth at the nerves of the inner palea. In the examination of the seeds, their devel-

opment has been left out of consideration, the rather high average percentage of seeds without teeth in this uncleaned material thus being partly due to the fact that even empty glumes (most frequently "lowest seed") have been taken into consideration, and partly to the fact that the seeds at the time of harvesting were over-ripe. Owing to this circumstance some of the seeds had probably fallen off, which resulted in the samples containing a comparatively large number of "lowest seeds" as at it is usually the uppermost seeds in the spikelet that are lost.

(2) Seeds from about 15 plants of the second generation of 14 different families of the Danish strain Tystofte No. 152 have been examined. This particularly good material was kindly placed at our disposal by the manager, P. O. ANDERN, of the experiment farm "Roskildegaarden". 100 seeds from each sample have been examined; 95,8 per cent. had distinct teeth at the middle of the marginal nerves. The 4.2 per cent. seeds without teeth varied in these samples from 0 to 9 per cent.; these seeds, which could in nearly every case be identified as the lowest seeds in the spikelet, had long teeth at the nerves of the inner palea.

(3) Moreover, of the two species in question the following samples (50 seeds from each), whose origins are not so definitely known as that of the afore-mentioned have been examined: 15 Danish (7 Tystofte No. 152), 10 Westernwolths Grass (from the Dutch State Seed Testing Station at Wageningen), 3 French, 1 New Zealand and 1 Argentina. On an average, 5.8 per cent. of seeds without teeth at the middle portion of the marginal nerves of the outer palea — varying from 0 to 10 per cent. — were found in these samples, but in respect of these seeds the same holds good as stated in paragraph (2).

B. *Perennial Rye-grass.*

(1) As in the case of Italian Rye-grass, seeds of Perennial Rye-grass were harvested from 25 single plants, from different plots in the experiment garden of the Danish State Seed Testing Station; 12 of the 25 plants were of the Danish Lundbaek strain, 2 were described simply as Danish, 7 Irish, 2 Scotch, 1 English and 1 Polish. 50 seeds from each plant were examined.

With the exception of 1 "uppermost kernel", which has teeth

from the top down to a little below the middle, teeth were not found at the middle portion of the marginal nerves (Fig. 14β).

(2) In 1920 we received from H. N. FRANDSEN, the experimental farm "Otoftegaard", comprehensive and valuable material consisting of 165 samples of seed from single plants of the Lundbaekstrain, the mother plants of which in most cases had been isolated. Of each of these samples 100 seeds were tested. In 150 of the samples no teeth were found at that portion of the marginal nerves of the outer palea marked *b* in Fig. 2. In the other 15 samples 60-100 per cent. toothed seeds were found. In 6 of these samples, moreover, the greater portion of the seeds were awned. 4 samples, contained, on an average, 5.5 per cent. seeds without teeth, being similar in this respect to Italian Rye-grass, according to our observations; 5 samples contained, on an average, 24 per cent. seeds without teeth.

At our request, H. N. FRANDSEN has very carefully gone through his notes on the cultivation trials with the 15 plants in question and others of the same parentage. So far as 13 of these samples were concerned, it could be shown that the mother plants had been hybrids (crosses between the two Rye-grass species in question). As regards the remaining two samples (Nos. 56 and 88) it was impossible to demonstrate that crossings had taken place. On the contrary, Mr. FRANDSEN had suceeded in producing from plants of exactly the same strain as those mentioned, individuals having the appearance characteristic of Perennial Rye-grass. The only samples for which the criterion "marginal nerves without teeth" did not hold good were Nos. 56 and 88; these will be sown to ascertain, if possible, whether they are hybrids.

Further I have several times had the opportunity of making observations on some hundreds of single plants of Perennial Rye-grass which were planted out at "Otoftegaard" for the purpose of improvement. All of them — with the exception of one (probably a recessive form from an accidental cross) — had marginal nerves without teeth.

(3) The following samples, whose origins are not so definitely known as those of the samples mentioned in paragraph (2), have been examined; 5 Danish (the Lundbaek strain), 3 Scotch, 2 Irish, and 2 New Zealand. In no case were seeds found having teeth at the middle portion of the marginal nerves.

(4) Several samples sent in for testing at the Danish State

Seed Testing Station have shown the same criterion. In those cases where toothed seeds occurred in the samples, awned seeds were also found in the purity determination.

Mention should also be made of the fact that during these three years work in the laboratory and in the field, I have frequently made observations on seeds of these two Rye-grass species. For the purpose of control we have sown a few seeds in sterile soil, but unfortunately most of the plants were destroyed by frost in the hard winter 1923-24. The remaining plants, however, proved that the conclusion already reached was correct.

Finally, stress should be laid on the fact that the two closely related species in question easily cross with one another, and that it may never be possible to find a method or testing in which the possible presence of hybrids thus produced can be ignored. In order to be able to form an opinion as to the occurrence of such types, sowing and artificial crossing are of course necessary.

II. *Rye-grass — Meadow Fescue.*

The criterion most often used by the Seed Testing Stations to distinguish between Rye-grass and Meadow Fescue (*Festuca pratensis* Huds.) is the difference in shape of the rachilla. This criterion, which has been described by a number of authors, will in most cases suffice, but now and then such seeds occur as are difficult to determine because the shape of the rachilla is not typical of either of the species in question, or because the rachilla is entirely absent. In such cases it is desirable to have other criteria.

Mention should therefore be made of the fact that when the basal parts of seeds of these species are seen from the back, differences are revealed at the point where the seed has been attached to the spikelet. Perennial Rye-Grass seeds have most frequently narrower and more tightly fitting " basal parts " (Fig. 15δ) than those of Italian Rye-grass (Fig. 15ε), but the difference is not sufficiently distinct to afford a certain means of distinguishing between them. It can only be employed as confirming a determination of the identity of the species. The " basal part " of Meadow Fescue is, on the contrary, generally broad and so to speak " clubbed " and there is a very open furrow between the " basal part " and the seed (Fig. 15ξ). Further, the shapes of the seed of the species in question are

somewhat different. The seed of Perennial Rye-grass is nearly rectangular, that of Italian Rye-grass oval, and that of Meadow Fescue a little wry, notably tapering off towards the base.

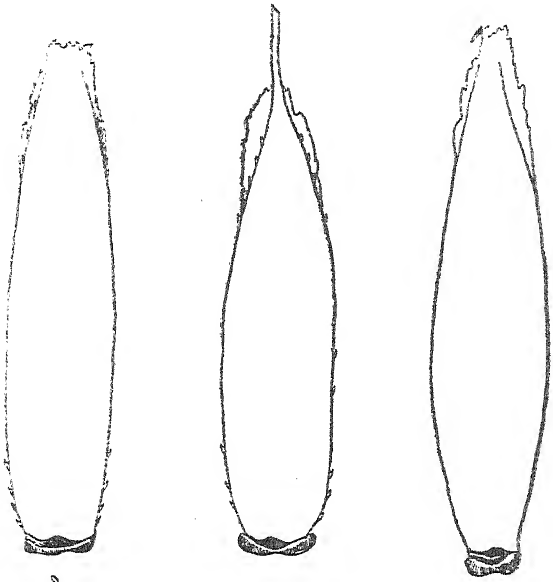

FIG. 15. — δ = *Lolium perenne* L.
ε = *Lolium italicum* Braun.
ξ = *Festuca pratensis* Huds.

In contradistinction to those of Rye-grass, seeds of Meadow Fescue are all smooth; they are only exceptionally furnished with comparatively small teeth at the upper portion of the outer palea.

The teeth at the nerves of the inner palea are smaller than those of Rye-grass.

E. HELLBO

Assistant to the Danish Seed Testing Station.

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Abstracts and Literature.

The Evaluation of Hard Seed.

BROWN, E. (United States Department of Agriculture). *Report of the Fourth International Seed Testing Congress in Cambridge, 1924.* London, 1925.

The Association of Official Seed Analysts of North America have, in consideration of the importance of establishing a uniform basis for labelling seeds, adopted, the following rule :—

" In reporting the germination of samples of leguminous seeds, a portion of which usually remains hard at the end of the test (*i. e.* does not take up water readily under normal conditions for germination), the actual percentage of germination should be reported, and also the percentage of seed remaining hard ".

The need for further investigation on the adequate evaluation of hard seeds is now fully recognized by the American Seed Trade.

M. L. Y.

The Determination of the Botanic Identity of Varieties in Laboratories and in Experiment Fields.

CHMELAR, F., Director, Seed Testing Station, Brünn. *Ibidem.*

Attention is drawn to the importance of preparing a detailed description of the characteristics of varieties both in the field and in the laboratory to assist in the drawing up of guarantees of genuineness and purity of seed.

The author describes some of the more frequent characteristics associated with varieties of sugar beet, potatoes, wheat and barley.

An exchange of observations taken on trial grounds in various countries would be very beneficial in this respect.

M. L. Y.

Seed Testing.

CHMELAR, F. (Director, Seed Testing Station, Brunn). Study of the methods and standards established with a view to regulating seed testing, and the regulations concerning the foreign and home seed trade. *Publication of the Ministry of Agriculture,* No. 33, 312, pp. 57 illustrations. Prague, 1923.

The author discusses critically the various methods of seed testing employed in the different countries and in Czecho-Slovakia. He describes in detail especially the method adopted in Austria, Germany, Hungary, Switzerland, Denmark, Holland, and in the United States, and makes a short review of the situation and work of the Seed Testing Stations in Sweden, Norwy, Finland, England, France, Belgium, Yugo-Slavia, Spain,

Roumania, Poland, Russia, Italy, Canada, Japan, Australia, New Zealand, and Uruguay. Reference is made to the 3rd International Seed Testing Congress held in Copenhagen 6th-10th June, 1921; to certain new methods of testing, the PIEPER, HEINRICH, and NEMEC-DUCHON methods; the determination and provenance of seeds; to the identification of potato varieties, and to certain apparatus useful in seed testing.

In the second part, the author deals with official regulations established in the various States with regard to the seed trade. A short account is given of State regulations adopted in other countries (Holland, England, Canada, France, United States, Hungary) and examples are given of laws and ministerial orders put in force in Czecho-Slovakia with reference to such questions.

A comprehensive bibliography of 483 titles is appended.

M. L. Y.

Germination Test at Low Temperature, with particular Reference to Seeds which are not fully After-Ripened.

FRANCK, Dr. W. J. (Director, State Seed Testing Station, Wageningen). 3 figs., bibliography. *Report of the Fourth International Seed Testing Congress in Cambridge, 1925*. London, 1925,

Germination at low temperature is discussed under two headings:— physiologically unripe seeds, and seeds which are after-ripened, that is to say the artificial ripening of hitherto dormant seeds owing to adverse conditions. This delayed germination has been attributed by some investigators to physiological deficiencies of the embryo, and by others to seed-coat characters.

The author describes in detail the after-drying method employed at Wageningen, which has proved successful in the case of rye, wheat, oats and barley (the last named requiring sometimes a longer period) and also for other seeds such as: (*Alopecurus pratensis, Alpium graveolens, Arrhenatherum elatior* (husked), *Avena flavescens, Cichorium endivia, Dactylis glomerata, Lepidium sativum, Nasturtium officinale, Poa* spp. (*Poa compressa* excepted), *Solanum Lycopersicum*, etc.

Comparative tests were made recently with various flower seeds. A low temperature either constant at 10°C. (e. g. *Chrysanthemum carinatum, Delphinium ajacis, Eschscoltzia* pp.), or between 10° and 20° C. (e. g. *Clarkia* spp., *Lobelia erinus*) is the most favorable. For cereals, a temperature of 10° C. gives the highest germination results.

M. L. Y.

The Determination of Plaut Diseases Transmitted by Seed.

GENTNER, G. (Director, Official Seed Testing Station, Munich). *Ibidem.*

The importance of a thorough investigation as to the possible transmission of disease in seeds, is clearly demonstrated in the germination tests carried out in Munich.

The author describes the methods employed and gives a list of the causal organisms (bacteria and fungi) detected in various seeds.

M. L. Y.

The Vitality of Buried Seeds.

Goss, W. L. (Seed Testing Laboratory, Bureau of Plant Industry, United States Department of Agriculture). *Journ. Agric. Research*, XXIX, 7, pp. 349-362, 2 tables, 1 plate, bibliography, 1924; and *Report of the Fourth International Seed Testing Congress in Cambridge, 1924*. London, 1925.

In 1902, a buried seed experiment was started in the Seed Testing Laboratory, United States Department of Agriculture. Since then viability tests have been continued up to 1923 and a complete record has been kept of the percentage germination in relation to depth planted.

The records given indicate that depth has little effect upon preservation of vitality. The weed seeds show the highest percentage of germination, especially species such as :-- *Rumex* spp., *Portulaca oleracea*, *Datura tatula*, *Plantago* spp., *Ambrosia* spp., *Chenopodium* spp., and *Chrysanthemum leucanthemum*.

Of the 107 species buried in 1902, 71 grew in 1903 after one year, 61 grew in 1905 after 3 years, 68 grew in 1908 after 6 years, 69 grew in 1912 after 10 years, 50 grew in 1918 after 16 years, and 16 grew in 1923 after 20 years.

Observations made during the periods indicated, have led to the conclusion that seeds of most weeds when ploughed under will retain their vitality indefinitely during normal crop rotation. This fact renders futile any attempt to control weeds by this method. The preservation of seeds buried in the soil, in order to help maintain a continuous vegetative cover for the land should not, however, be overlooked. M. L. Y.

Some Critaria by means of which Seed of the Poa Species can be Identified.

Hellbo, E. (Danish Seed Testing Station, Copenhagen). *Report of the Fourth International Seed Testing Congress in Cambridge, 1924*. London, 1925.

As criteria in the identification of the most common varieties of the *Poa* species, the Danish State Seed Testing Station has used teeth and hairs at the marginal nerves of the inner palea of the seed. In this report, it is pointed out that the different way in which the teeth are shaped or placed on the upper half of the outer palea, or the absence of teeth, can amongst others, be used as criteria in the distinction between the six most common *Poa* spp. Briefly, these criteria are as follows. —

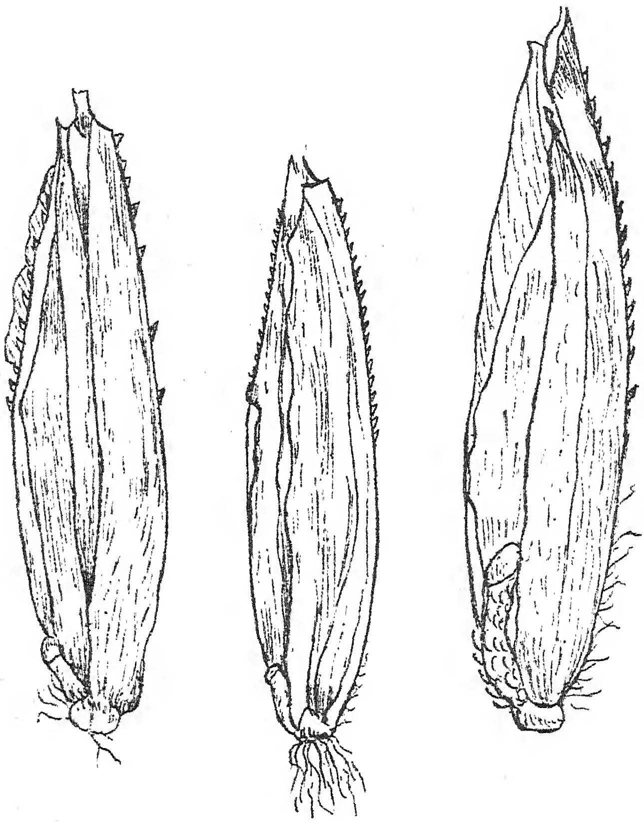
Poa pratensis L. (Fig. 16 *a*) has big, spread teeth on the dorsal nerve of the outer palea; *P. trivialis* (Fig. 16 *b*), small and close-fitting teeth; *P. nemoralis* (Fig. 16 *c*), *P. palustris* (Fig. 17 *d*) and *P. compressa* (Fig. 17 *e*) have medium sized teeth, slightly bent; *P. annua* (Fig. 17 *f*) has no teeth on the dorsal nerve of the outer palea.

The three species with medium sized teeth can be distinguished from each other in the following way :—

P. nemoralis has a hairy rachilla, whereas the other five species have either a smooth or wart-like rachilla.

P. palustris has a yellow shining spot on the upper part of the outer palea.

P. compressa has a short very open seed (*i. e.* fruit together with the inner and outer palea), and most frequently a short and stiff rachilla.



a *b* *c*

FIG. 16. — *a* = *Poa pratensis* L. — Large teeth on dorsal nerve of outer palea (to right in figure). The inner palea has been removed from the outer palea and the large teeth on the left marginal nerve of the inner palea have become visible (to left in figure).

b = *Poa trivialis* L. Small teeth on dorsal nerve of outer palea (to right in figure). To the left part of outer palea has been removed and small teeth on left marginal nerve are visible.

c = *Poa nemoralis* L. Hairy rachilla and medium-sized bent teeth on dorsal nerve of outer palea.

The shape of the seeds of *P. annua* differs much from that of the other *Poa* species (see Fig. 17 *f*).

In the investigation, a binocular microscope magnifying about 40 times is used. The seeds are placed in a row on a slide and take up, as a rule, a position suitable for observation.

It is frequently possible under the microscope to see the teeth on the nerves of the inner palea (Figure 16 *a* and *b*) a condition which is often a

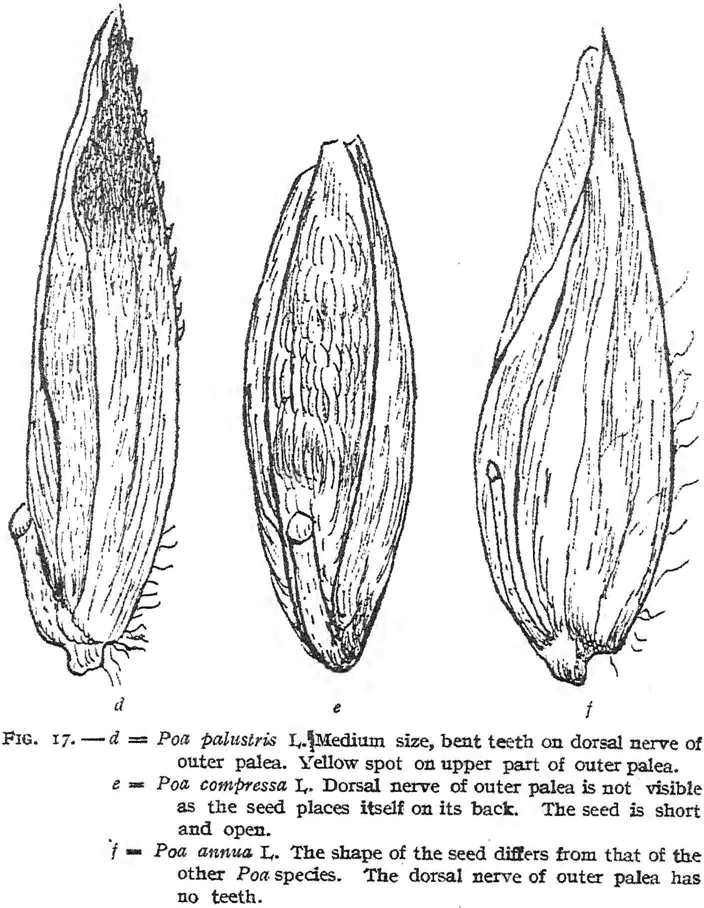


FIG. 17.—*d* = *Poa palustris* L. Medium size, bent teeth on dorsal nerve of outer palea. Yellow spot on upper part of outer palea.
e = *Poa compressa* L. Dorsal nerve of outer palea is not visible as the seed places itself on its back. The seed is short and open.
f = *Poa annua* L. The shape of the seed differs from that of the other *Poa* species. The dorsal nerve of outer palea has no teeth.

great help in the identification of a variety. By means of the method described, the determination of genuineness of species can be made considerably more rapidly than by means of the method hitherto employed at the Danish State Seed Testing Station, in which the seed before investigation under the miscoscope has to be soaked, in order to prepare the outer palea so that the teeth might be visible.

These descriptions are based on observations of threshed seed in the

same condition as seeds generally found in the samples sent in for testing at the State Seed Testing Station; but the aim has also been to find a method suitable for use in the examinations at the seed testing stations.

M. L. Y.

The Interpretation of Seed Testing Results,

LAFFERTY, H. A. (Head of Seed Testing and Economic Botany Division of the Department of Agriculture, Irish Free State). *Journ. Dept. of Lands and Agriculture*, XXV, 1, pp. 33-39, tables 6, 1925; and *Report of the Fourth International Seed Testing Congress in Camqridge, 1924*. London, 1925.

The author discusses the so-called "Irish" method of procedure adopted in testing certain kinds of seeds as compared with the "Continental" method.

According to the Irish" method, empty or only partially filled seeds of the varieties in question are considered as pure seeds, and are included in germination tests. The purity is therefore high, although germination tends to be low The contrary is evident in the Continental system. Such seeds are in this case considered as impurities and are removed before proceeding with the germination test, which is reserved entirely for specially selected seeds.

Improvement in quality of seeds on the market is, however, noticeable since seed-cleaning machinery has been perfected. This is very evident in the case of the improved cleaning of rye grass seeds (*Lolium perenne*), which has resulted in an almost complete elimination of light seeds from commercial consignments.

The hypothesis that lack of uniformity is liable to occur where the Continental system of testing is employed, is shown to be misjudged on examination of the following results of comparative tests with seeds distributed by the Danish Seed Control Station to the principal Seed Testing Stations throughout the world:

TABLE I. — *Results of comparative Tests of Red Clover, White Clover and Alsike Clover.*

Station	Red Clover		White Clover		Alsike Clover	
	% Purity	% Germination	% Purity	% Germination	% Purity	% Germination
Continental method:						
Zurich	96.7	89 + 8	96.9	65 + 21	94.4	90 + 6
Copenhagen	97.5	92 + 6	96.6	71 + 20	94.9	91 + 5
Wageningen	97.1	92 + 6	96.4	71 + 22	95.5	90 + 4
Paris	97.7	94 + 2	98.4	75 + 14	95.0	92 + 3
Cambridge	97.2	91 + 3	97.0	68 + 21	94.4	90 + 4
Edinburgh	98.0	91 + 6	97.4	71 + 18	95.4	90 + 4
Irish method:						
Dublin	98.8	91 + 6	97.8	71 + 15	94.7	89 + 5

TABLE II. — *Results of Comparative Tests of Timothy, Vetch and Swede.*

Station	Timothy		Vetch		Swede	
	% Purity	% Germination	% Purity	% Germination	% Purity	% Germination
Continental method:						
Zurich	98.7	86	90.4	69 + 6	96.7	84
Copenhagen	96.8	88	91.4	75 + 6	98.5	86
Wageningen	98.7	88	86.2	75 + 8	93.5	87
Paris	99.1	90	91,6	70 + 5	98.3	75
Cambridge	96.5	90	88.7	75 + 6	97.3	80
Edinburgh	99.1	89	90.3	68 + 8	96.7	74
Irish method:						
Dublin	98.9	86	91.9	72 + 8	99.3	86

The differences in results (taking into account the limits of latitude, in estimating percentage) are limited. In the case of *L. Perenne* and cocksfoot (*Dactylis glomerata*) the *quality* of the seed is considered the deciding factor, and the wide variations observed in certain cases are limited entirely to low grade seed containing a large proportion of 'light' seeds. This is shown in the results of comparative tests with fair quality Italian ryegrass seed, compared with inferior samples.

TABLE III. — *Results of Comparative Tests of Samples of Italian Ryegrass Seed of Fair Quality.*

Station	Italian Ryegrass	
	% Purity	% Germination
Zurich	96.6	71
Copenhagen	96.3	71
Cambridge	96.5	71
Edinburgh	97.2	71
Dublin	98.9	70

TABLE IV. — *Results of Comparative Tests of a Sample of Perennial Ryegrass of very Inferior Quality.*

Station	Perennial Ryegrass % Purity	Perennial Ryegrass % Germination
Zurich	80.7	93
Copenhagen	78.8	93
Wageningen	79.2	93
Paris	79.2	92
Cambridge	81.6	92
Edinburgh	83.6	93
Dublin	96.4	54

Table of Latitudes for Purity.

When the Purity is	The latitude allowed is
At or between 100-98 %	± 1 %
At or over 90 but less than 98 %	± 2 %
At or over 80 but less than 90 %	± 4 %
Less than 80 %	± 5 %

Table of Latitudes for Germination.

When the Germination is	The latitude allowed is
At or between 100-95 %	± 4
At or over 90 but less than 95 %	± 6
» 85 » 90 %	± 7
» 75 » 85 %	± 8
» 55 » 75 %	± 9
» 45 » 55 %	± 10
» 25 » 45 %	± 9
» 15 » 25 %	± 8
» 10 » 15 %	± 7
» 5 » 10 %	± 6
Less than 5 %	4

In order to avoid conflicting results, the Seed Testing Station at Dublin has prescribed certain fixed rules for the guidance of seed merchants who wish to take a representative sample of a large bulk of seed. Retests are undertaken when differences are reported outside the prescribed limits.

M. L. Y.

The Work of the Association of Official Seed Analysts of North America, 1921-1924.

MUNN, M. T. (President of the Official Seed Analysts). *Report of the Fourth International Seed Testing Congress in Cambridge, 1924.* London, 1925.

Since 1921, the seed testing work in North America has progressed considerably, and some twenty or more laboratories can be now relied upon to give dependable results. Certification work is based upon thorough training and experience of the analyst, adequate laboratory equipment, quality of work as shown by the results of tests, and the whole-time application of the analysts to testing in its various phases. This system tends to precision and maintaining a high standard of work.

The importance of following the fixed rules set out by the Association of Official Seed Analysts is emphasised. A purity analysis is not considered complete unless it shows the percentage of pure seed, weed seeds, inert matter and other crop seeds. In reporting upon the viability of a given lot of seed, it is considered advisable to ascertain the percentage of germination in terms of normal sprouts, and in addition, the percentage of hard seeds and impermeable seeds, when testing Leguminoseae.

Questions such as the hard seeds, provenance, vegetable and flower seeds germination, longevity, seed-borne diseases, effects of frost and seed disinfection, are being studied in conjunction with fundamental germination studies upon which testing can be based.

The necessary valuation attached to the sale of seeds is discussed. Statements as to purity, viability and weed seed content, and in many ases, provenance, are considered essential in the seed trade, and the enforcenent of the seed law on a practical basis is urgent.

M. L. Y.

Adulteration of Rape and Turnip Seed with Charlock Seed.

ROGENHOFER (Government Seed Testing and Protection Institute' Vienna). Verfälschung von Raps und Rübssat durch Ackersenfsamen. *Oesterreichische Landwirtschaftliche Marktzeitung*, No. 15, p. 1. Vienna, 16 April, 1925.

Seed testing carried out by the author at the Government Institute showed that much of the rape and turnip seed placed on the market recently, is largely adulterated with charlock seed. The charlock being of a much lower oil content diminishes considerably the usefulness of rape and turnips for oil production, and if used for sowing, since it may cause overgrowing of the fields by weeds, the seed becomes almost valueless. Three samples of rape sent for testing were found to contain 36, 39 and 75 % of charlock seed; three samples of turnip seed were found to contain 45, 47 and 49 % of charlock. The adulteration was much more easily detected in the case of rape, since the rape seed has a diameter of 1.75 to 2 mm., while the charlock seeds have a diameter of only 1.50 to 1.75 mm., and the seeds of turnip and charlock are so very similar in size that they can be distinguished only through careful attention to the colours. The charlock seed

which has been named *B. pullorum* can readily be differentiated from other members of the colon-typhoid group. The hen is the original source of infection and the organism is deposited in the yolk of the eggs from the ovary in which the infection is localized.

The agglutination test is termed positive when the serum is capable of agglutinating the organism in a dilution of 1-100. A positive agglutination test does not indicate infected ovaries in all cases, as the infection may be localized elsewhere in the body. Furthermore, young fowls may retain the agglutination but not the infection, from having had the disease as chicks.

In Holland *Bac.* Klein is given as the cause of bacillary white diarrhoea.
B. I. C. TE H.

A Case of Mange in a Goose.

CIUREA, Sur un cas de gale chez l'oie. *Archiva veterinara*, p. 64, 1925.

Only one case of mange in a goose was reported in 1905, by NEUMANN, which was caused by *Cnemidocoptes prolificus.*

The present case appeared on a young goose, the head and neck of which show bare patches and lumps, more or less solid, about the size of a pin-head, prominent on the external and internal surfaces.

Under the microscope, the formations show a cylindrical canal, the walls of which are lined inside with a very thin hyaline coating. After treatment with alcohol, the canal shows a large number of hexapod larvae, measuring about 135 μ in length and 112 μ in width.

The question of infection by *Cn. prolificus* still remains.
B. J. C. TE H.

A Study of Blackhead in Chicks at Missouri State Poultry Experiment Station.

ERIKSEN, S. *Poultry Science*, Vol. IV, p. 250.

During the past two years a number of inquiries have been received in regard to blackhead in chicks. This disease has been very prevalent.

Symptoms and lesions are similar to blackhead in turkeys. Losses are usually less severe than in the case of turkeys, varying from one or two individuals to over fifty percent.
B. I. C. TE H.

Pseudo-tuberculosis in a Hen caused by *Cladosporium*.

GALLEGO, A. Contribución a la Histopatología de las micosis. Sobre un caso de pseudotuberculosis micótica en la gallina. *Revista de Higiene y Sanidad Pecuaria*. Vol. XV. No. 10.

A case of a pseudo-tuberculous tumour on the neck of a hen caused by *Cladosporium.* The cause appeared to be tuberculosis, but a microscopical examination made by the author showed that this was not the case. In the tissues no tuberculous bacilli were found, but after treatment with silver carbonate *Cladosporium* was discovered.
B. I. C. TE H.

Vaccine Therapy of the *Epithelioma Contagiosum* of Fowls.

GALLI-VALERIS, B., Impftherapie der Geflügelpocke. *Schweizer Archiv für Tierheilkunde*, p. 243. Lausanne 1925.

Epithelioma contagiosum of fowls, a fairly frequent disease in certain countries, does not seem to be very prevalent in Switzerland. In 27 years the author has seen only one case. This fowl showed, besides the localization in the mouth and the eye, *virus* of the *epithelioma* in the form of false diphtheric membranes. GALLI is still of opinion that there are certain bacteria of diphtheric form, quite independent of the *epithelioma*.

TOYODA says that the passing of the *virus* through the rabbit enabled him to obtain a *virus* which, inoculated in the child, the sheep and the fowl, protects them against the inoculation of the vaccine. Vice versa, he has protected man against the *epithelioma* by the intermediary of the vaccine lymph.

HADLEY and BEACH say that one cc. of their vaccine, inoculated under the skin, gives an immunity of two months to more than two years. T. HENNEPE advises this vaccine not only as a preventative, but as a cure.

In two cases GALLI has cured fowls by these injections, and the importance of vaccine therapy in *epithelioma contagiosum* of birds seems to himto be proved. B. T. C. TE H.

Experimental Research regarding the Lungs of Birds.

JAULMES, C. Recherches expérimentales sur le poumon des Oiseaux. *Comptes rendus des Séances de la Société de Biologie*. Meeting held 7th. November, p. 1147.

In the lungs of birds accumulations of " dust " are found in the middle of lymphoid formations situated on the wall of the mesentery, as well as in the mucous chorion of the parabronchial walls. They are also found very exceptionally, in the aerial capilliaries themselves. These dust particles, are either free, or confined, sometimes very numerous in the cells with large clear, more or less coloured nuclei and with abundant protoplasm, granular, and vacuolated.

A pigeon receives in an introchial injection 2 c.c. of a sterilized mixture of oil and carmine. After fixation it is seen that in the lung the oil is stopped only at the entrance to the parabronchi, and is again found there in small quantity, almost all of it is passed directly into the left abdominal aerial sac, where it appears as a red coating, adhering locally to the dorsal and internal part of the sac.

The ciliated parts of the wall of the sac are not modified by contact with the oil, and the epithelium alone seems to react. In the transverse sections, at first the epithelial cellules grow considerably, swell in the cavity of the sac, and finally detach themselves from it. Then these cellules which have become free, attach themselves to the globules of oil and carmine, and absorb them energetically, mixed with numerous *leucocytes* which also take part in the process. A fibrous net fixes these different

elements in its web. At the points of maximum reaction the epithelium entirely disappears.

It is a question, therefore, of an almost exclusively epithelial reaction comparable, up to a certain point, to that of the pulmonary epithelium of the mammals. This peculiar reaction, and the knowledge of existence of ciliated zones added to the embryological facts concerning the aerial sacs, gives good evidence of their physiological importance and their nature of "bronchial circuits" shown by A. JUILLET.

B. T. C. TE H.

The Macroscopic and Microscopic Anatomy of the Intestine of the Goose and Pigeon.

KAISER, H. Inaugural address 1925, Hochschule Hannover, *Deutsch Tierärzliche Wochenschrift*, p. 729, 1925.

It is scarcely possible to distinguish the individual intestinal sections of birds as can be done in the case of mammals. Dual blind intestines occur. In the goose they are quite well developed, in the pigeon only slightly. These caeca serve principally to split up cellulose.

In the case of the goose the author found a *valvula iliocaecocolica* at the place where the blind intestine opened into the *ilium.*

The total length of the intestine depends partly on the food. The intestines of geese which have a very large amount of fodder, are longer than the intestines of those which feed exclusively on grain.

The intestine of the goose and the pigeon is lined with hairy tufts. Structural folds are absent from the small intestine. In the case of the pigeon there are no *noduli lymphatici*, but in the goose they are found on the side opposite to where the mesentery is fixed.

Their direction of length lies parallel to the direction of length of the intestine. In the smaller intestine of the goose the author found two types of tufts:

(1) those with a wide base and relatively small height;
(2) those with a narrow base and relatively great height.

The tufts are arranged in two step-like rows.

The *tunica muscularis mucosae* in the intestine of the goose consists of longitudinal and circular layer. The longitudinal muscular layer is not very prominent.

The genital glands are alveolary-tubular in the pigeon, and tubular in the goose.

B. T. C. TE H.

Fowl Typhoid and Fowl Cholera.

KAUPP. B. F. and DEARSTYNE, R. S. (Agricultural Experiment Station, North Carolina State College of Agriculture and Engineering).

An interesting report on two dangerous poultry diseases which are found probably in all countries where poultry husbandry is practised. In the introduction KAUPP says: "Intensive raising and forced production has separated the domestic fowl so widely from its original primitive

condition that its susceptibility to disease is greatly increased. The information of the average poultry man as to poultry diseases is meagre. Frequently diseases are allowed to become well established before the seriousness of the position is recognized. A rapid correction of such conditions is impossible. It must be brought about by education through all possible agencies ".

The subject of this bulletin is the investigation af septicaemic diseases of poultry in North Carolina, a subject of great economic importance to the State.

The historical account begins with the investigation of the Italian physician BARONEO who, with MIOCCHI and BRUGNATELLI examined epidemics among poultry in Lombardy between the years 1709 and 1790.

The first reference however to the typhoid-like disease of birds in which the organism is given a definite name is that of G. KLEIN in 1889, who gives details of an extensive epidemic among fowls in Kent, (England). MOORE described in 1895 the same bacterium under the head of *Bacterium sanguinarium.*

More recent publications are: SMITH and TEN BROECK (1915), RETTGER and KOSER (1917), GOLDBERG (1917), HADLEY (1919), TE HEUMPE and VAN STRAATEN (1921), TRUCHE (1923).

In 1924 the North Carolina station published a comparative study of the European strains of avian typhoid with those of North America, no outstanding difference being found in the biological activities or in the general character of the disease produced by these various strains.

The causative organism is known as *Bacillus gallinarum*, or KLEIN'S bacillus and in 1917-20 the Society of American Bacteriologists adopted the classification of BERGEY and gave the causative organism of avian typhoid as *Eberthella sanguinaria* (MOORE), by which name it is now recognized by the American school.

KAUPP gives further cultural characteristics, field studies., symptoms of the disease, artificial infection, pathological anatomy, control measures.

In the summary it is stated that: 1. The disease is probably prevalent in all countries where poultry husbandry is practised.

2. Avian-typhoid is non-pathogenic to man. Chickens are very susceptible to the disease, turkeys and guinea fowl are less susceptible, pigeons, ducks and geese are only slightly susceptible. Young chicks probably are not susceptible under field conditions.

The causative organism has many features in common with members of the colon-typhoid group.

3. The carrier of avian typhoid is a menace to poultry. Sparrows and pigeons have been shown to be conveyors of the disease.

4. Typhoid may be controlled by sanitation, isolation, or destruction of suspects, safe disposition of the carcasses of birds dying of the disease, disinfection of drinking water and the prophylactic vaccination of healthy birds. Vaccination produces an immunity of unknown duration but the single inoculation should immunize the bird for the period of duration of the disease in the flock. B. I. C. TE H.

The Effect of Lactic Acid on *B. pullorum*, *B. avisepticus* and *B. sanguinarium* and its Influence in the Control of Intestinal Disease of Poultry.

KAUPP, B. T. and DEARSTYNE, R. S. *Poultry Science*. Vol. IV, p. 242.

The investigation has a practical bearing on the lactic acid value of buttermilk as used for poultry feeding, since the lactic acid is not destroyed in the preparation of either condensed or dried buttermilk.

By these experiments it is shown that the effect of lactic acid in milk is to create a field in the intestinal tract, unfavourable to harmful bacteria. B. I. C. TE H.

Goitre in Poultry.

KEMKAMP H. C. H. (Minnesota Agricultural Experiment Station). *Journal of the American Veterinary Medical Association*, p. 223, 1925.

Goitre occurs most frequently in man, but also in all domestic animals. There are few reports of it having been found in birds.

Of 2409 autopsies on poultry for the past six years, from all sections of Minnesota, only two cases of goitre in birds were reported. Both were White Orpington hens and came from the same farm.

One of these hens is shown in an illustration. The thyroid gland measured 3.2 cm. in the antero-posterior diameter, and 2.5 cm. in the transverse diameter. Microscopic section showed that the cause in those cases was simple goitre. B. I. C. TE H.

Avitaminose in Relation to Poisoning.

MORSELLI, G. *Biochimica e terapia sperimentale*, I, p. 1, Milan, 1924.

In all experiments for the closer chemical determination of vitamins this crucial point of the subject has as yet scarcely been approached. It is now sought by new means to clear up the question of *avitaminose*. A material deficiency can theoretically be brought about by a disturbing foreign body being introduced in the course of the cell chemistry. If this foreign body retards a physiological cell-constituent in its function, then this is equivalent to deficiency, if the total effect be considered. A body which interrupts the process of the cell chemistry can very easily become a poison. In this manner we attempt to connect toxicological investigations with *avitaminose research*. The author made use of the *tetanus* and *dysentery toxinus*, and obtained results similar to those of SETTI and TAKAWA. B. T. C. TE H.

Influence of the Sympathetic Nerves on the Movements of the Muscular Stomach of Birds.

NOLF, P. Influence des Nerfs sympathiques sur la motricité de l'estomac muscolaire de l'oiseau. *Comptes rendus des séances de la Société de Biologie, Société Belgee* p. 839. Meeting held 25th. July 1925.

In birds, the sympathetic nerve fibres going to gizzard and the duodenum start from the 3rd. to the 5th. dorsal nerves. They go to-

wards the origin of the coeliac artery, and form a nervous plexus intimately attached to this vessel. The nervous fibres destined for the gizzard and the duodenum follow the branches of the coeliac artery which are distributed to these organs. Each of the four branches originating from the coeliac nerves contains motor and inhibitory fibres, with a predominance of inhibitory fibres in the branch issuing from the 6th. dorsal nerve.

The gizzard and the duodenum of the bird, therefore, receive motor fibres and inhibitory fibres from the vaque and coeliac nerves.

Contrary to what is usually seen when an organ is furnished with a sympathetic and non-sympathetic nerve system, there is not, as regards the gizzard of graminoivorous birds, any real functional antagonism between the fibres of the vaque and the fibres of the sympathetic nerves. Each of these nerves can function negatively, since each contains motory and inhibitory fibres.

In accordance with the lack of functional differentiation between the fibres of the vaque and the sympathetic, it is found that atropine suppresses the motory effect on the gizzard and duodenum as completely for the sympathetic as for the vaque.

A sufficiently intense excitation of the peripheral end of a vaque nerve, or of the cut coeliac nerves, is capable of provoking a series of rhythmical contractions of the gizzard. If, shortly after the commencement of a series, there is substituted, for the air which the animal is breathing, air mixed with carbonic anhydride or hydrogen, the contractions stop, but are resumed if pure air is given.

From what occurs, it seems as though the excitation of a mixture of motory and inhibitory fibres were followed by a motory or inhibitory effect, according to the contents of CO_2 and O_2 in the blood which bathes the neuro-muscular junction.

In four experiments anaesthetization did not stop the excitation of the ganglionic cellules, but prevented them from acting on the muscular tissue.

B. T. C. TE H.

The Barnevelder.

POWELL-OWEN, W. Published by the *Feathered World*, 9 Arundel Street Strand, London W. C. 2.

This fully illustrated book, by the well-known club judge of the Biitish Barnevelder Club, contains a detailed description of the standard bird, with some excellent plates of plumage, for the benefit of the beginner. Also much general information on colour breeding, selecting for shows, and laying tests, and exhibitions of breeds.

The rise in favour of Barnevelders came so suddenly and has spread so rapidly that very many think that it is an entirely new breed, which is not the case, as, if we were not familiar with the breed name we were quite accustomed to the trade-term, " Dutch all-browns ", which covered their products on the London egg market. It is of interest, however, to note that " Dutch all-brown " eggs realised regularly more per dozen

than the best English eggs. Size and colour were alone responsible for the increased prices for the Barnevelder eggs sent to us from Holland.

The British Barnevelder Club was formed in May 1922, the standard drawn up and submitted to the Poultry Club for recognition and acceptance, and the first Club Show was held in 1923 at Olympia. In the same year a section for the breed was arranged at the Harper Adams College laying test, there being twelve entries.

The Club already has about 200 members. The Dutch standard gave much difficulty to the British breeders. There is a difference between the British and the Dutch standards. The British standard allows for two varieties of hens, viz., the Double-Laced and the Partridge. The splashed pattern did not gain favour in England. In Holland, the Barnevelder Club has only one standard, the double-laced, which is called the exhibition-variety.

The illustrations of plumage in this booklet are very clear.

With reference to the Black Barnevelder the author says: "I have always supported the Black Barnevelders because I consider that the more varieties of a breed there are, the greater is its strength".

B. I. C. TE H.

Text-book on Poultry Diseases.

REINHARDT, Dr. R. Leipzig, *Lehrbuch der Geflügelkrankheiten*, 2nd. Edition, published by M. and H. Schaper, Hannover, 1925.

The first edition appeared in 1922, and now the second has been issued. The book is very much improved, and recent publications have been taken into account. Two new chapters are added on tumours and malformations. The number of illustrations has also been increased. The book can be recommended for European conditions. B. T. C. TE H.

The Occurrence of Organisms Resembling Actinomyces in the Caecum of a Hen.

ROSKIN, G. Ueber das Vorkommen von aktinomycesartigen Organismen in einem Hühnersarkom. *Centralblatt für Bakteriologie, Parasitekunde und Infektionskrankheiten*, Part II, p. 472, 1924.

Communication on the occurrence of bacteria resembling *actinomyces* in a circular-celled caecum from near the crop of a hen. In connection with this, the author asks whether the infectiousness of the caecum of a hen cannot perhaps be traced to a parasitic source. B. T. C. TE H.

The Histology of the Thyroid Gland of Birds.

SCHESKIN, J. (Veterinary High School, Vienna). Beitrag zur Histologie der Vogelschilddruce. *Wiener tier. Monatschr*, p. 575, 1925.

The thyroid glands of the domestic cock, turkey-cock, goose, duck, crow, partridge, pigeon, jay, blackbird and sparrow were examined. With the larger birds the thyroid gland is egg-shaped, caudal, with a yel-

low appendix. The presence of a *membrana propria*, as recorded in literature, is not corroborated. There is no regular law shown in the protoplasmic structure in a bird species. The older the individual is, the more strongly coloured are the follicle contents. The KRAUSE colloid colouring does not give uniform results with animals of the same age of different species, so that this technique cannot have the importance for the histology of the thyroid gland of birds, which is accepted on many sides with respect to the thyroid of mammals. In the interstices of the thyroid gland of birds are often found typical lymph follicles, often with embryonic centres.

B. T. C. TE H.

Esaltin with Avitaminose in Vitro Bio-chemistry and Experimental Therapy.

SETTI, G. *Biochimica e Terapia sperimentale*. p. 234 1924, p. 553, 25. Milan.

The author calls the substance, which in boiling shelled rice increases the energy of germs, esaltin. The object of the examination was to determine whether this substance is a crystalloid or a colloidal substance. The esaltin proved to be very resistant to heat, and was obtained in the form of crystalloid bodies.

B. T. C. TE H.

General information.

Circular to the Members af the Association. — I have pleasure in announcing that arrangements have been made with the International Institute of Agriculture, Rome, for the printing in its *International Review of the Science and Practice of Agricultre*, of communications and notes supplied by our Association, which will thus become the medium for dissemination of information relative to Poultry Instruction and Investigation, and will be widely distributed in all parts of the world. In that connection are two important factors, namely, that the *Review* is issued in several languages and will be seen by Departments of Agriculture in all countries.

Further, this *Review* is issued four times in each year and every member of the Association whose subscription is paid, will receive free of charge, copies as published.

I am very pleased to say that Dr. B. J. C. TE HENNEPE of Diergaardesingel, 96a, Rotterdam, Holland, has consented to act as Editor. I ask, on his behalf, for your co-operation and support, to enable him to take full advantage of the new arrangement and to make more widely known the results of experience and research, which until now have been available only to a few.

Request is made that bulletins, reports, publications and communications be forwarded as soon as issued, direct to Dr. B. J. C. TE HENNEPE. His attention should also be called to new works on Poultry and if possible, copies should be sent to him so that notices of these may be made in the *Review*.

E. BROWN,

President of the International Associations of Poultry Instructors and Investigators.

SPECIAL ACTIVITIES
OF THE BUREAU OF AGRICULTURAL SCIENCE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

PLANT DISEASES AND PESTS IN HAITI

I.

The most important plant diseases of Haiti are :—

1. — Cotton bacterial boll rot.

This is a disease of cotton bolls which occurs in a very serious form when the cotton bolls mature in wet weather. It very frequently seems to follow the attack of cotton stainers. It may be so severe that during rainy seasons not a single boll will come to normal maturity. The bolls may become soft, watery and rotted during almost any stage of their growth. They finally turn brown and blackish and remain as mummies on the plants. No satisfactory control measures have been worked out. With the annual cottons it would not be such an important disease, since the planting season could be regulated so as to produce fruiting in the dryer season.

2. — Cotton mosaic.

Cotton mosaic is also a very important disease in Haiti. It prohibits the profitable growing of certain well established and profitable varieties of cotton grown in other cotton producing regions of the world. The nature of the disease is not well understood. It appears in the native cotton, producing some damage but never becoming a limiting factor. The growing of certains introduced varieties has been abandoned on account of this di-ease. There appear to be very marked varietal differences. The

Plant Pathology Department in co-operation with the Agronomy Department aret esting this year, on the Experiment Station plots, a number of varieties planted at different times in order to determine varietal resistance, environmental factors affecting the disease, etc.

3. — Mosaic of sugar cane.

One of the most serious diseases in Haiti at present, is the mosaic of sugar cane. It is generally distributed and very destructive throughout the Island. Uba, an immune variety, is being grown to a considerable extent by the Haitian-American Sugar Company. The indications are that this or other resistant varieties will greatly relieve the situation. Improved cultural conditions may also greatly aid in keeping the disease under control.

4. — Kernel smut of grain sorghums.

The kernel smut of the grain sorghums (" Petit Mil " in particular) causes much loss in this important food and feed crop. In many fields the damage amounts to 50 % of the crop. It is judged that the average loss for the Island is upward of 10 %,

5. — Mosaic of tobacco.

The mosaic of tobacco is without question the most serious disease of tobacco in Haiti. In the larger plantations of tobacco particular care is now being taken to keep the seed beds and young fields as free of this disease as possible.

6. — Mosaic of beans.

Several varieties of beans, particularly the variety " Red Kidney ", suffer considerable loss from mosaic. Hot weather favors the disease to such an extent that their growth is sharply limited to the cooler season, except in the high mountains.

7. — Mosaic of corn (maize).

Mosaic of corn (maize) is very general and does considerable damage wherever corn is grown in the Republic.

8. — Black rot of sweet potatoes.

The black rot of the sweet potato is of considerable economic importance because of its prevalence and because the sweet potato is an important food crop. The damage from this disease may range up to 90 % of the crop. Very little attempt has been made to control this disease, perhaps largely because it is a local crop grown in small plots.

There are in addition to the above many diseases of more or less minor importance, due to the fact that they cause periodic or slight damage to important crops or else the crops upon which they occur are not economically important crops.

* * *

A new disease to which particular attention has been given this year is the fruit rot, or black rot, of pineapple. This disease appears on fruits that are nearly mature. It is rarely found on fruits that are more than ten days from ripeness necessary for canning purposes. One or more eyelets may be infected or in severe cases the entire inner portion of the fruit is affected. In no cases are there external indications of the disease. The disease commences as brownish spots in the placentae or as brownish strands in the eyelets, spreading until the entire eyelet is browned or blackened by dry rot, which may or many not spread to adjacent eyes, but does not affect the connective tissues. It is an extremely serious disease of pineapples affecting perhaps 50 % of the fruits, rendering them unsuited for canning or for shipping during the season when the disease is severe. It is a very complex disease. It has been previously noted in the West Indies. Brief notes concerning its occurrence may be found, but the cause or control measures have never been determined. Extensive experiments are now being made to ascertain the cause and to devise possible control measures.

* * *

The Plant Pathology Department of the Technical Service, Department of Agriculture, Haiti, has, since its initiation some fifteen months ago, been making an intensive survey of the plant disease problems existing in Haiti. These observations have been

recorded on a plant disease survey form. Much valuable information concerning the prevalence, distribution, and seriousness of the economic diseases has thus been gained. Two definite research problems have been undertaken. The first of these is the fruitlet rot or black spot of pineapple described above. Isolation of various fungi, yeasts and bacteria have been made and inoculations effected. The reactions of the inoculated fruits are now being studied in the field. Various physiological factors which may in some way cause or contribute to the disease are also being studied under field conditions. Varietal tests and selection experiments are also being started. The second problem receiving attention is the mosaic of cotton. Very little has been published concerning the nature and cause of this disease. We have obtained seed of as many varieties of cotton as were available and are making comparative planting at various seasons to study the various seasonal effects upon the development of the disease, to study varietal resistance in connection with studies upon infection and the development of the disease. It is proposed to study in this connection the effects of hybridization and selection.

H. D. BARKER,
Plant Pathologist to the Department of Agriculture and Technical Instruction, Port-au-Prince (Republic of Haiti).

II.

The Insect pests observed in Haiti are :—

I. — INSECT PESTS OF COTTON.

The important insect pests of cotton in Haiti are :—

(*a*) the leaf caterpillar, *Alabama argillacea* Hubner;
(*b*) the stainer bug, *Dysdercus andreae* Linnaeus;
(*c*) the red spider, *Tetranychus bimaculatus* Harvey;
(*d*) the white scale, *Hemichionaspis minor* Maskell.

The Pink Bollworm, *Pectinophora gossypiella* Saunders, is a serious pest on Sea Island cotton, but does little damage to native cotton, which is more extensively grown.

2. — Insect pests of coffee.

Coffee has not any serious insect pests.

3. — Insect pests of sugar cane.

The seed of sugar-cane is attacked by a termite, *Nasutitermes (Tenuirostritermes) pallidiceps* Banks, which also sometimes does serious damage to corn. The leaves of sugar-cane are often eaten by a caterpillar, *Calisto pulchella* Lathy, the stalk is bored by the caterpillars of *Diatraea saccharalis* Fabricius, and the roots are eaten by white grubs, *Lachnosterna hogardi* Blanchard. Sugar-cane, and to a much greater extent, corn, is often damaged by army-worms, *Laphygma frugiperda* S. & A.

4. — Insect pests of sweet potatoes.

Sweet potatoes are attacked by the weevil borer, *Cylas formicarius* Fabricius.

5. — Insect pests of bananas.

Bananas are attacked by the root borer, *Cosmopolites sordidus* Germar.

6. — Insect pests of coconut-trees.

Young coconut trees are often attacked by rhinoceros beetles, *Strataegus quadrifoveatus* P. B., and the leaves by the scale *Aspidiotus destructor* Signoret.

7. — Insect pests of citrus trees.

Citrus trees are infested with most of the common scale insects, as well as by the black fly, *Aleurocanthus woglumi* Ashby.

* * *

Demonstrations in the control of the cotton caterpillar have been made by the Technical Service, showing the desirability of dusting with arsenicals, and the largest cotton plantation in the country has replaced its spray pumps with dust guns.

A demonstration on the destruction of the West Indian Cane Leaf-Hopper, *Saccharosydne saccharivora* Westwood, by means of dusting with calcium cyanide was made, but this was thought too dangerous for use by ordinary labor, and what at one time threatened to become a serious outbreak gradually disappeared, due to natural causes.

Demonstrations in the destruction of ants, especially *Solenopsis geminata* Fabricius, by means of the BARBER formula of poisoned syrup, both in houses and around citrus trees have been made, and in the destruction of termites, *Nasutitermes morio* Latreille, by placing arsenicals in their nests. These have been made directly by the Department of Entomology, and do not include those made by agricultural agents or teachers, nor instructions given to other persons for the control of insect pests.

GEORGE N. WOLCOTT,

Entomologist to the Department of Agriculture and Technical Instruction, Port-au-Prince (Republic of Haiti).

AGRICULTURAL INTELLIGENCE

ECONOMICS.

Economics.

1. **Diversification of Crops.**

Tropical Agriculture, Vol II, No. 5, pp. 93-94. Trinidad, 1925.

The recent depression in certain tropical products brings into prominence the fact that one-crop areas are based upon an unstable economic foundation. While the main crop is in demand at remunerative prices the country prospers, but when any disaster overtakes this crop the whole area is thrown into profound depression. Much may be said in favour of specialization of large areas, but the inherent danger of the system should always be remembered by planters and administrators.

A well-known example of a one-crop area is that of the coffee industry of Ceylon, which was prosperous until in 1868 the disease *Hemeliea vastatrix* appeared and practically destroyed the industry. Other crops were then cultivated, and salvation was ultimately found in tea, which was introduced on sound economic lines; although the failure of the Ceylon tea industry would be very serious for the island, owing to the introduction of other crops, such as cinchona, cinnamon, rubber and coconuts, the effect of failure of tea would not be so disasterous as was the case with coffee.

A more recent example is that of the rubber industry of Malaya, and also that of Ceylon, in this case due to over-production, with the consequent fall in market prices.

Another instance is that of cocoa; the production of the Gold Coast rose from 39,000 metric tons in 1912 to 194,000 tons in 1923. Recently prices fell, owing to a variety of causes, with serious results to the producing areas.

A remedy may lie in cooperation to extend the market, to limit production, or by publishing reliable information regarding stocks and supplies. The chief remedy however lies in a greater diversification of crops.

The danger is again illustrated on a smaller scale by the failure of

the lime industry of Montserrat, brought about by disease, hurricanes and competition of the Italian lemon industry.

There are many minor crops in the tropics which could be developed into profitable industries if they received adequate attention.

The need is urged for practical recognition of the necessity of broadening the economic basis of those tropical areas whose fortunes are founded upon the continued prosperity of one main crop.

W. S. G.

2. **Dairy Farming on Arable Land.**

University of Leeds, Bulletin No. 138, pp. 54, plates 4, graphs 4, charts, 2. Leeds 1925.

The Bulletin gives an account of a system of cutting and feeding of green forage to dairy cows, to supplement or take the place of pasture during the grazing season. The work was carried out at the Soiling Farm, Rawcliffe, Yorkshire, from 1920 to 1924.

The Bulletin describes: the experiments and the results obtained; the factors which affect the relative efficiency of soiling crops and grass pasture for milk production; the possibilities of reducing the cost of milk.

In an appendix are shown: details of cropping; annual valuations; tables comparing economic results with those of other farms in Yorkshire; graphs of milk yields; charts of schemes of cropping. W. S. G

3. **Hard Winter Wheat Grower's Problem.**

GRIMES W. E. (Kansas State Agricultural College) *Journal of Farm Economics*, Vol. VII, N° 2, pp. 196-219, tables 9. Columbus, Ohio, 1925.

The author discusses the various conditions brought about during and after the War, their effects on production in the winter wheat belt, and the adjustments which farmers must now make owing to changed conditions of production and altered price relations.

The different aspects of the problem are treated and the following recommandations made:

1. Adjust the wheat acreage per farm to that which can be sown properly with the usual labour force and equipment of the farm.
2. Produce dark, hard, high protein content wheat for which millers are paying premiums.
3. Secure for the grower the premium paid for high grade wheat.
4. Encourage cooperation by farmers, and the adoption of improved varieties of crops.
5. Encourage the keeping of livestock on the wheat farm, to utilize labour, bulky feeds and by-products.
6. Educate the farmer with respect to improved methods and market demands. A market news service is essential.
7. Research work on production and marketing is necessary.

There are many other allied problems such as credit, transport, taxation, etc., but the author is of opinion that the adjustement which may be

made by the individual farmer are the most fundamental, as the ultimate solution of the present difficulties is dependent upon individual action.

W. S. G.

4. The Economic Interpretation of the Results of Fertility Experiments.

WORTHEN, E. L. *Journal of American Society of Agronomy*, Vol. XVII, No. 4, pp. 233-244, tables 4, bibl. Geneva, N. Y., 1924.

The author is of the opinion that calculations of financial returns from fertiliser experiments are almost without exception favourable to the fertiliser.

The various factors which influence the accuracy of the financial interpretation of results are discussed, examples are given, and the following conclusions drawn:

Adequate consideration has not been given to error in calculation of financial returns from fertiliser plot experiments. As a result the conclusions indicate a most liberal return on the fertiliser investment.

Conservation in determining financial returns from experiments is highly desirable, and particularly so in periods of general price decline of agricultural products.

Unless financial conclusions conform more nearly with the returns that would be secured in actual farm practice, farmers may disregard all agronomic teaching.

W. S. G.

5. The Economics of Soil Liming.

SLIPHER, J. A. *Journal of the American Society of Agronomy*, Vol. XVII, No. 4, pp. 211-232, figs. 12. Geneva, N. Y., 1925.

Increase in crop yield resulting from a particular soil treatment is of academic interest and is a scientific index of soil plant relationship. The true measure rests upon the net value of the produce above its cost of production.

The outlay in liming, in addition to the cost of material, should include the cost of harvesting and marketing the crop increase. The liming costs proper should include cost of material, freight, expense of wagon haul, and spreading on the land. Wagon haul costs 50 cents for the first mile and 30 cents per ton for each additional mile.

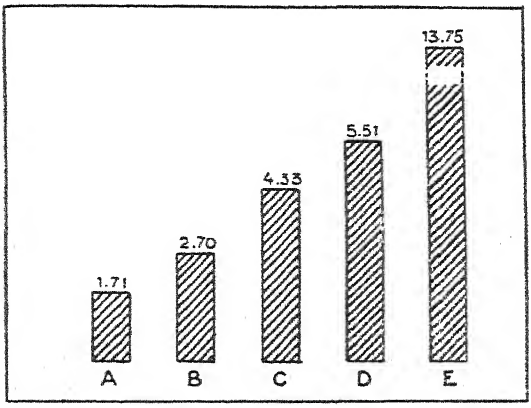


FIG. 18. Area per year from individual crops. Dollars per acre — Net profit.

A = cereals, B = other forage, C = pasture, D = legumes, E = roots.

Spreading costs per acre, 57 cents for a 500 lb. application and $1.60 for 8000 lb.

The first gain from liming is that cost of tillage is reduced. Capital or land profit is the second. One dollar net return in crops per year justifies $10 higher land value. The land profit, based on returns from tests in 17 States, amounts to $40 per acre.

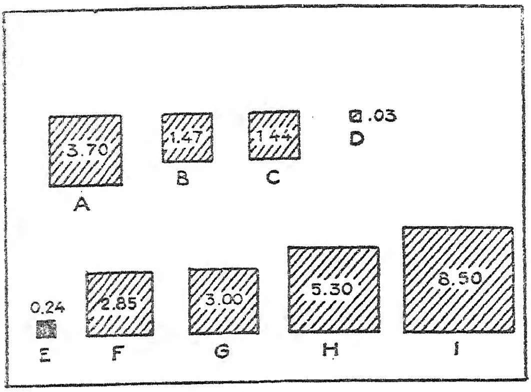


FIG. 19. — Net profit from crops, by types. Dollars per acre per year.

A = maize, B = rye, C = wheat, D = oats, E = cowpeas, F = timoty, G = soybean, H = clover, I = alfalfa.

The third gain is that of crop increases, the value of which is sufficient to afford a net profit of $4 per acre per year.

Considered as an investment, liming has returned 138 % on all outlay in the 17 States studied.

Root and legume crops gave the highest profits from liming and cereals the least. Alfalfa gave the greatest return, followed by clover, soy bean, timothy, maize, rye, wheat and oats.

Light applications proved the best investment in 13 comparative tests; a single application was always more profitable than multiple increments.

W. S. G.

6. **Payment in Kind in German Agriculture.**

HUCHO, W. Die Naturalentlohnung in der deutschen Landwirtschaft. *Berichte über Landwirtschaft*, Vol. II, No. 4, 80 pp., 13 tables. Parey, Berlin, 1925.

After discussing the development of payment in kind which, under normal conditions is slowly disappearing and giving way to payment in money, the author deals in detail with the pecuniary evaluation of wages in kind. It is necessary for the levying of taxes, for workers' insurances and for the labourer himself, and furnishes data of comparison for the payment of wages in kind as well as in money. The payment of wages entirely in kind hardly occurs anywhere in Germany nowadays. The temporary introduction on the Isle of Rügen as a consequence of inflation, has not proved practical when the return to the normal currency took place. But in times of fluctuating currency the whole evaluation of wages is different, and then it is well to establish as a unity of measure not money, but the chief products of the crops, as these are more or less

permanent in value, in Germany rye and potatoes are used for this purpose.

Subsequently the author treats of the different sorts of payments in kind at present employed in combination with payment in money, and points out the effect and the importance still due to the former in agriculture and in national economy as a whole. The appreciation of wages in kind in the form of lodgings and land emoluments, he thinks often exagerated, most of all where the land let to the labourer is not permanently held, for instance, where the labourer is given a different piece of land every year on account of crop rotation.

Wages in kind have not prevented unmarried men from leaving the land, but they have done so in the case of permanent, married day labourers, especially where the land given as wages in kind was not changing but settled land. The effects of wages in kind on the working of the estate itself are discussed, and finally the possibilities are considered under which payment in kind may still, and must, play a part in the future.

Above all things, a clear, estimated, commutation of payment in kind into a fixed value, consequently for the time being into money value, is necessary, and this commutation must also be satisfactory to the labourer himself; and further, wages in kind ought to be given in the actual, exact equivalent of payment in money, and not, as has often been done hitherto, indiscriminately. H. I. H.

AGRICULTURAL INDUSTRIES.

Plant Products.

7. The Nipah Palm and Alcohol Production in British North Borneo.

DENNET. J. H. *Malayan Agricultural Journal*, Vol. XIII, No. 3, pp. 64-71. Kuala Lumpur, 1925. (1)

It is estimated that there is an area of at least 300 000 acres of Nipah Palm in British North Borneo, available in blocks up to 5000 acres, extending up the river estuaries for distances of nine or ten miles.

Nipah Palm in the Federated Malay States, owing to exploitation, has become an agricultural undertaking, whereas in British North Borneo, owing to different conditions it remains a forest product.

A factory with an experimental plant capable of producing 200 gallons of motor spirit per day has been erected, and tapping the palms for juice was started in January, 1924 and continued until June.

The motor fuel produced consists of about 70 % alcohol and 30 % ether with the addition of 1 % of aniline. It is claimed that the motor

(1) See *R.* 1923, Nos. 112 and 492. (*Ed.*)

fuel has an effeciency of 80 %, as compared with petrol, also that engines require less lubricating oil, do not over-heat and require decarbonising less frequently.

It is considered that it should be possible to produce fuel at a price sufficiently low to compete successfully with petrol. W. S. G.

8. **Ginning Pima Cotton in Arizona.**

TOWNSEND, J. S. *United States Department of Agriculture. Bulletin* No. 1319, pp. 11, plates 11. Washington, D. C., 1925.

On account of the diversity of roller-ginning methods used in Arizona, Pima cotton in the bales often differed so much that it was considered to be uneven in quality. In reality Pima cotton is more uniform than any of the seed stocks obtained from Egypt.

As a result of investigations made by the Arizona Department of Agriculture, an attachment has been devised for removal of the lint from the gin roller in a manner that straightens the fibres and improves the appearance of the cotton ; by the use of the new attachment the cotton is placed in a higher commercial grade.

The Bulletin describes the methods in use for ginning Pima cotton, and contains photographic illustrations of the lint at the different stages of ginning. W. S. G.

9. **The Determination of Moisture in Flour.**

SPENCER, G. C. (Bureau of Chemistry, U. S. Department of Agriculture). The Quantitative Determination of Moisture in Wheat Flour. *Journal of the Association of Official Agicultural Chemists*, Vol. VIII, No. 3, p. 311, 7 figs. Washington, D. C., 1925.

Grain flour is composed of extremely small particles of an organic body, these particles varying in cell structure and chemical nature and presenting an enormous surface for the attraction and retention of atmospheric moisture. In flour, as in other substances with a cell structure, and in powdered carbon, the moisture is in close contact with the finely divided particles and adheres much more tenaciously than water which may be easily detached from solid surfaces. Also on applying the simple law of attraction it will be understood that, given the influence of the proximity of the water and the particles of flour, it is impossible to drive off all the particles of water, since the vapour pressure is insufficient to overcome absorption.

Hence all the methods hitherto adopted to determine the moisture of flour are liable to err ; the one used must be accepted by all those interested. In the United States a maximum moisture of 13.5 % is allowed and the drying of two grams of flour in a current of dry hydrogen, or in a vacuum at the temperature of boiling water to constant weight (for 5 hours approximately) is prescribed. In this official method however there is no indication of the reduction of pressure used, and this causes various investigators to obtain different results.

The author has made numerous tests with different methods, always using aluminium capsules with a cover, 60 mm. in diameter and 18 mm. deep, and has come to the conclusion that the simplest, most accurate and quickest method is the following: About 2 grams of flour are placed in a closed and covered capsule; the cover is taken off and the capsule kept in a furnace at a temperature of 130°C. for one hour. The cover is then replaced and after the capsule has been left in the desiccator for 20 minutes, it is weighed. A. F.

10. **The Future of the West African Palm Oil Industry.**

BARNES A. C. *Tropical Life*, Vol. XXI, N° 2, pp. 18-19. London, 1925

The growing importance of vegetable oils is obvious, and until recently West Africa was the chief producer of palm-oil and kernels, but competition has arisen owing to the improved methods of cultivation and organisation adopted in Sumatra and Malaya. It is estimated that in five years the export of palm-oil from Sumatra will exceed 60 000 tons per annum.

The author alludes to developments now taking place in Sierra Leone, the Gold Coast Colony, and Nigeria; in the last-named colony attention is being paid especially to native methods of extraction, as the methods now in use are extremely wasteful. It is estimated that the internal consumption of palm-oil in Nigeria is about 100 000 tons per annum.

The author is of opinion that the quantity of oil produced annually could be more than doubled if the whole of the produce of the palms now in bearing were utilised, to the best advantage. W. S. G.

11. **Production of Sweet Silage by American Methods in Austria.**

KUPELWIESER. Maisbau und Erzeugung von Silage nach amerikanischem Rezept. *Wiener landwirtschaftliche Zeitung* No. 10, March 7 1925, pp. 2, figs. 4, Vienna.

The increased importance of dairy farming has had as a consequence in Austria the effort of developing in a higher degree the cultivation of forage by the laying down of artificial meadows and the promotion of grass-seed cultivation. The necessity is evident of devising a better method for the preservation of fodder as hay-making is so often delayed or even prevented by bad weather.

As a consequence, in many parts, different methods for the erection of silos are being tested, as recommended by industry and the inventors. No final opinion can be given as yet as to these trials, largely owing to the fact that the results of silage preparation vary with each year, according to the prevailing weather conditions at the time when the fodder was cut and placed in the silo or brought in for conservation; weather conditions, dryness and ripeness of the fodder itself, method of treatment and many circumstances are all of importance.

An interesting experiment has been made by Dr. Karl KUPPELWIESER who grew maize according to American methods of cultivation and stored it in a silo built from American plans. In so doing he acted upon

principles which, according to ideas hitherto prevailing in Austria, were considered as inadvisable. In Austria maize intended for fodder, is sown as closely as possible and is often broadcast. The object is to suppress the formation of fruit and to use the maize as green fodder as long as the cobs are still tender and small. KUPPELWIESER on the contrary, grew the maize in rows one metre apart and the plants in each row were placed at a distance of 15-25 cm. Here and there sunflower seeds were sown. The field was hoed three times, between the plants.

The harvest began on the 4th of October. The cobs were in a state of milk ripeness, and in the sunnier places showed signs of full ripening.

After drying off during fine weather for several hours the fodder, 1120 meterzentner (220 cwt.) on 5 hectares, was cut into pieces of about 2 cm. by a powerful American chaff-cutting machine and blown into a ferroconcrete silo. This silo had an internal height of 11.60 m. and a volume of 184 cu. metres. Every day a layer of 100 to 150 cm. was filled in and spread evenly and trampled down by a boy. After the days work was done, two men again trampled down the mass of fodder for ten minutes each, especially at the edges. In this also KUPELWIESER abandoned the general Austrian custom, as by having the fodder trodden down he prevented the formation of a high temperature and a strong fermentation. As the fodder never got warmer than 30°C no butyric acid bacteria developed, the formation generally of which is suppressed by spreading the fodder lightly and so trying in order to obtain quickly a temperature of 55-60° C., which prevents the development of the butyric acid bacteria. However it almost always happens that butyric acid is formed during the time in which the heating of the silage takes place and when its temperature is above 30°C. and below 60°C. It is obvious that the amount of butyric acid produced is larger when the critical temperature period is prolonged. (This explains why with the method usual in Austria the amount of butyric acid formed in a silo is sometimes considerable in one case, whereas with fodder harvested under better, drier conditions, the quantity is quite small).

By having the mass of fodder trodden down, and so excluding air, KUPELWIESER prevented the formation of excessive fermentation also, the fact that the constituents of the maize were for the greater part in the form of starch and only to a slight extent in the form of sugar, which is more easily fermentable, had a preventive influence on fermentation.

The upper layers of the silage in the silo were covered with maize leaves, but without cobs and then with turnip leaves on which were placed a well-fitting layer of planks on which stones were put. The silo was filled up to a height of 10 m. but after several weeks the fodder had sunk to a height of 8.30 m.

At the beginning of January the cover was lifted and the upper spoilt layer was removed. Only at the borders, where air had penetrated, the fodder had become unfit for use. Where the boards were lying closely on the turnip leaves, these were in excellent condition.

The colour and smell of the fodder were very satisfactory. The individual parts of the plants, such as cobs, stalks and leaves were plainly

distinguishable. The woody constituents were completely softened. The silage is readily eaten by cattle, which are given 10 kg. per day.

The analysis of the fodder was as follows: acetic acid 0.12 %, lactic acid 0.66 %, butyric acid 0.0, water 77.19 %, crude protein 1.79 %, crude fat, 1.15 %, non-nitrogenous extract 10.99 %, crude fibre 6.23 %, ash 2.65 %. The sample was taken 50 cm. below the cover.

The experiment is interesting also for the reason that it was carried out at a height of 350 m. above sea-level, where in the middle of July the temperature only reaches 17.4°C., and which in consequence is not very suitable for maize cultivation. H. K.

12. **Silage Making in Tower Silos.**

AMOS A. (School of Agriculture, Cambridge) *Journal of Ministry of Agriculture*, Vol. XXXI, No. 11, pp. 1046-1051. London, 1925.

In the case of most silage crops grown in Great Britain, such as oat and tare mixtures or first crops of seeds, the most convenient time to make silage occurs between the hay and wheat harvest, or it may be done in periods of damp weather, or at times when haymaking is impossible.

As a general rule a crop for silage should be cut in a state of maturity rather more advanced than for haymaking, because there is much less loss during carting, and as the crop is ensiled shortly after carting there is little chance of any further formation of fibre.

The actual cutting of the crop may present various problems, dependant upon the particular crop and its condition at the time of cutting.

The quality of silage is affected by the interval of time between cutting and ensiling ; the best type, " green and fruity ", will probably be obtained when the interval is shortest ; acid silage is likely to result if the crop is allowed to become partially dry after cutting ; sour silage will be produced from a crop cut and exposed to rain for some days, so that decomposition starts in the field.

Loading in the field is facilitated by using low carts, or low-framed lorries, and when the crop has been cut and tied with a binder.

The choice of a silage cutter is important, as the speed at which the silo can be filled is largely controlled by the machine which cuts up the crop and elevates it into the silo.

In making silage it is essential to limit fermentation by the exclusion of air ; if air has access to the silage for a continued period, as by cracks in the walls of the silo, then the normal silage fermentation is followed by the growth of moulds and the silage is spoilt. Care must be taken to see that the walls are airtight and that air is excluded by trampling the crop. The level of the silage should be a little higher in the middle than at the sides of the silo.

The filling period should be sufficiently long to allow the silage in the lower and middle parts of the silo to ferment and settle, before completion of the filling. When intermittent filling of a silo is practised, however, the interval between two fillings must not exceed 60 hours, or a mouldy layer will be formed on the top, which will persist.

Under good conditions not more than 6 ins. should be spoilt, but with careless management 3 feet of top silage may be wasted. If on conclusion of filling, the crop is over-mature and dry, it is useful to add water to the crop as it passes into the silage cutter.

Various methods have been suggested for exerting pressure on the top of the silage in order to prevent access of air and thus reduce wastage, such as a layer of soil, or of wheat-chaff, etc. but no method seems truly economical. There is need of a device for the prevention or limitation of wastage of silage at the top ot tower silos. W. S. G.

13. **Flax Factory Management.**

BAKER, E. *Journal of Department of Agriculture, Union of South Africa*, Vol. X, No. 3, pp. 234-256, plates 20. Pretoria, 1925.

The author visited Europe in 1924 to investigate the flax industry with a view to its establishment in South Africa. A great deal of time was spent in studying methods of fibre extraction ; descriptions are given of the following :

(a) *Dew Retting*, found to be unsatisfactory under conditions obtaining at Durbanville, South Africa (1).

(b) *River Retting* : the finest fibre produced comes from Courtrai in Belgium, due to the properties of the river : some firms employ warmed river water to hasten the process. Details of processes are given with plans of factories and retting tanks.

(c) *The Peufallit System of Retting*, in which the flax straw is heated with steam under pressure for about 12 hours ; after drying in ovens the straw is ready for scutching The plant costs about £ 10,000. Belfast spinners reported that the flax was lacking in spinning quality.

(d) *Bacterial Cultures* : Professors CARBONE and TOBLER are carrying out experiments at Soran with cultures of *Bacillus felsineus*, but it has not yet been decided whether such methods are economically possible.

(e) *Chemical Methods of Retting* : the allusion to these methods is very brief : the underlying principle is the removal of pectin substances by chemical agency. Spinners complain of a loss of « quality », due probably to removal of the oily matter of the fibre.

Mention is made by the author of schemes for the collection of straw produced by growers, for treatment at central depots, and to the recent tendency in Ireland for the farmer to sell his standing crop in the field ; the buyer rets the straw, which he passes on to others who have specialized in scutching. Finally, the fibre is bought by a dealer who grades the fibre and sells it in large consignments to the spinner.

South African straw was treated in Silesia and it was noticed that retting was unsatisfactory owing to inequality in diameter of the straw. Thick straw retted sooner than thin straw, and the latter gave an additional 1.3 % of long fibre. Attention should be given to the production

(1) See *R.* 1923, No. 368. (*Ed.*)

of more uniform straw, which renders subsequent processes easier and more piofitable.

After retting and drying, straw should be stored for some months before scutching, and in South Africa scutching should be carried out in a humidified atmosphere. The chief fault with South African fibre is that it is more like horse-hair than silk, and as this difference represents from £ 50 to £ 100 per ton in market value, every care should be taken at this stage, by the aid of humidifiers, by scutching in winter or by other means, to make possible the production of a high grade fibre.

Breaking and Scutching : There are several kinds of mechanical scutching machines on the market, of which the « Etrich » is described as being the best. The machine is a combined breaker and scutcher, and is in use at one factory at least, in England, the manager of which factory states that the « Etrich » handles the retted straw at a cost of 18s. per ton as against about 80s. for hand-scutching. For the machine to work satisfactorily the straw must be well retted, dry, clean, and evenly fed into the machine. The « Etrich » plant at the above factory cost £ 2000.

Allusion is made to the different types of hand scutching wheels, e. g., the Irish with 6 heavy blades, the Belgian with 12 light blades, and a modification between the two, found satisfactory in East Africa. The choice of wheel depends upon the nature of the straw and the degree of retting to which it is submitted.

Attention is drawn to the importance of grading the fibre, which should be done only by experts. The article concludes with details respecting cost of production, based on wages and other factors now ruling is South Africa. W. S. G.

14. Packing Apples in the Okanagan Valley, British Columbia.

TAYLOR, H. V. *Journal of the Ministry of Agriculture*, Vol. XXXI, No. 11, pp. 1034-1046, figs. 4. London, 1925.

The author gives a brief description of the Okanagan Valley, its soil and climate, followed by details respecting the business methods of several cooperative fruit grower's associations which have been formed in the Valley. An account is given of the methods employed for receiving, grading and packing, and the dispatch of fruit to the various markets in the United States and to Europe. W. S. G.

15. Grading, Packing and Handling of Bananas.

ROWLANDS, W. *Queensland Agricultural Journal*, Vol. XXIII, No. 4, pp. 282-304, plates 97. Brisbane, 1925.

The object of the article is to aid growers in the preparation of bananas for market, so that they may obtain higher average returns and fewer losses.

The methods described are those employed by many successful growers in Queensland who have earned a high market reputation as consistent suppliers of firm, clean and well-packed fruit.

PLATE IV.

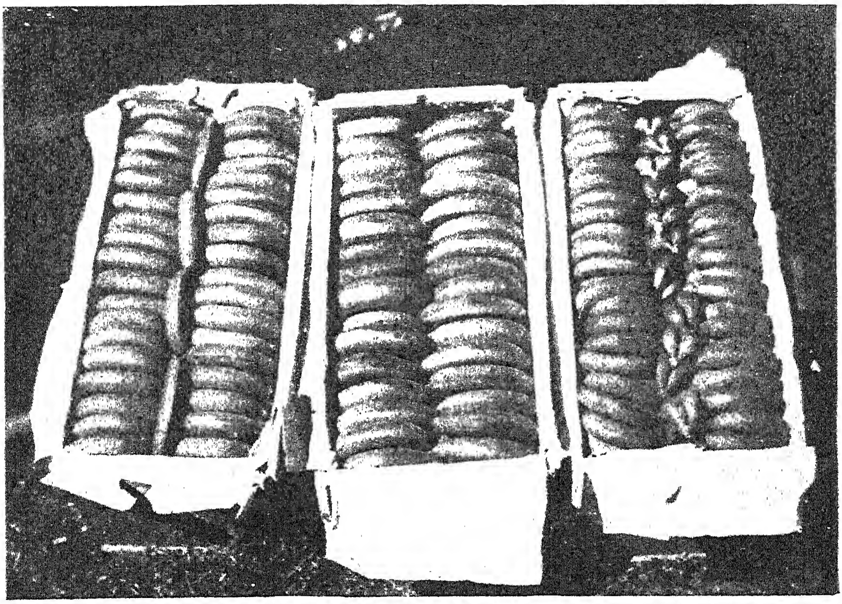


FIG. 20. — " Choice ", " Special ", " Standard ". Three cases of well-packed Bananas as opened in Melbourne.

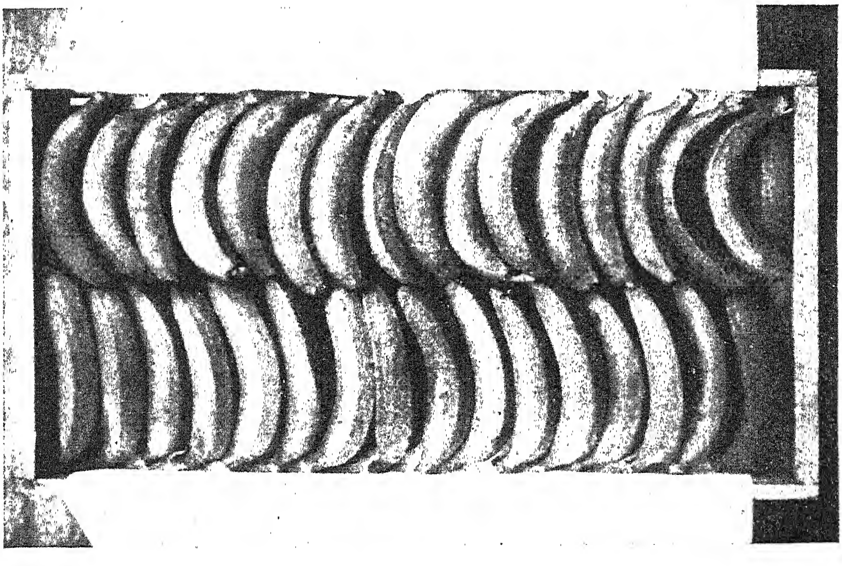


FIG. 21. — Method of packing bottom layer of " Special ".

PLATE V.

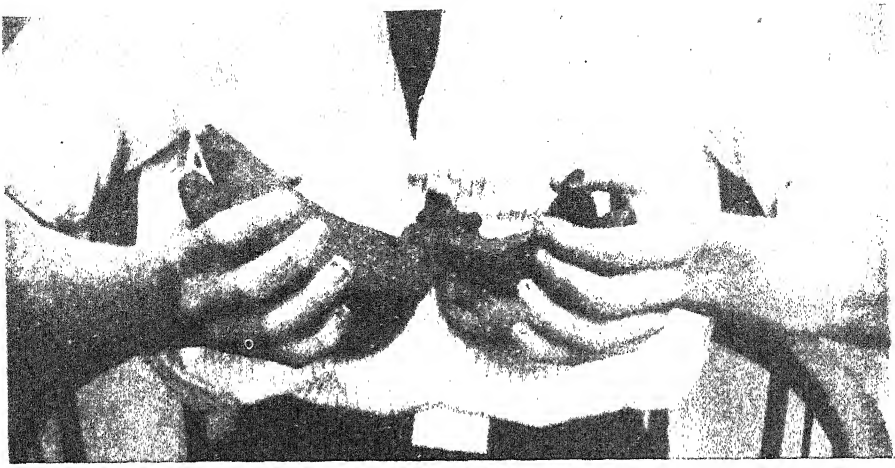


FIG. 22. — Correct method of breaking hands of Bananas.

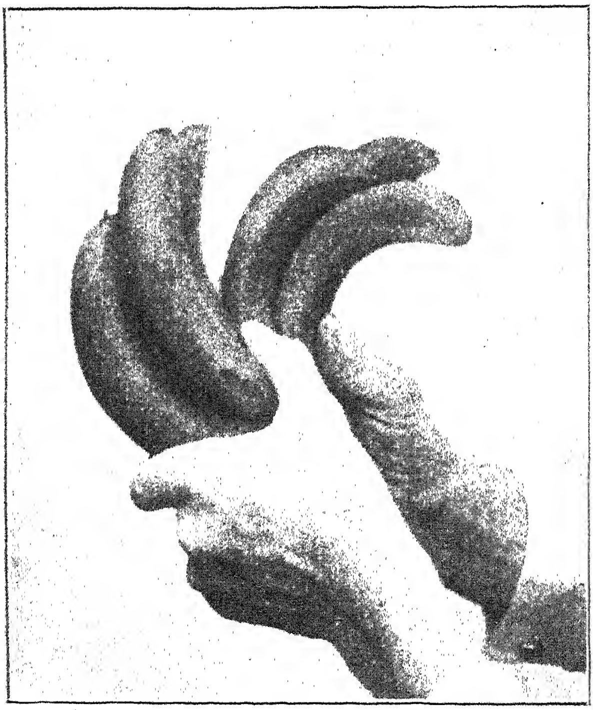


FIG. 23. —Wrong method of breaking hands.

The article is illustrated by excellent photographs (Plate IV, figs. 20,21; Plate V, figs. 22-23) and contains detailed instructions on the handling of bananas, from the time the fruit is harvested until it is graded and packed for the market. W. S. G.

16. **Refrigeration of Mangoes.**

HIGGINS, J. E. and PUNZALAN, E. S. *Philippine Agriculturist*, Vol. XIII, No. 10, pp. 443-449. Los Baños, Laguna, 1925.

Comparatively little systematic work has been done with respect to the refrigeration of tropical fruits. The object of the author's experiments was to make preliminary trials to indicate the best temperatures and conditions for later and more extensive experiments with mangoes. The work was carried out on fruit of the Carabao and Pico varieties, the former being one of the finest varieties known.

The fruits used in the experiments were all very similar as regards maturity, except that a few showed a slight loss of green colour; all were hard.

The experiments indicate that sound, green and hard, but fully mature Carabao mangoes, retain their condition under cold storage at about 36° F. for a period of 18 days or more, but not so long as 35 days. The fruit was in no way injured, and in flavour, texture and colour was equal to fruit which has not been stored. W. S. G.

17. **The Howard Method for Detecting Spoilage in Preserved Strawberries and Blackberries.**

NEEDHAM G. H. and FELLERS C. R. (Department of Food Preservation, University of Washington). *Journal of the Association of Official Agricultural Chemists*, Vol. VIII, No. 3, pp. 313-327, fig. Washington, D. C, 1925.

The enumeration of moulds, ferments and spores by the HOWARD method may also be applied to strawberry and blackberry preserves. These products cannot be preserved more than a day before proceeding to treat them. The presence of many moulds, determined by the HOWARD method, indicates a high percentage of musty or spoilt fruits; th presence of many ferments indicates that there are many spoilt and fermented fruits. Both deteriorations are observed contemporaneously.

The highest values for moulds are obtained when the pulp only is used; the juice contains fewer, and the mixture of juice and pulp still less. For the enumeration, the whole of the contents of the jar under examination should be utilized.

In strawberry jellies there is always a very small number of moulds, ferments and spores, whatever the condition of the product used. Strawberry or blackberry preserve on the other hand always contains a greater number of moulds than the raw product. Ferments show but few variations, and rather tend to decrease.

The presence of soft or over-ripe fruits, apparently unspoilt, gives a different value for moulds, especially in the case of blackberries. A. F.

Animal products.

18. **The Rape-Colewort Taste in Milk.**

ORLA JENSEN. Sur le goût de chou-navet dans le lait. *Le Lait,* Year V, Vol. V, No. 41, pp. 30-33. Paris, 1925.

The rape-colewort, or mustard taste, is due to the agency of certain species of bacteria capable of separating the mustard essence contained in the parent substance (a glucoside) met with more or less abundantly in all the crucifers.

The parent substance passes from the cow's udder directly into the milk and acts as a poison on young children. Nevertheless it is not the parent substance as such which imparts the flavour to the milk; there must have been a separation of the mustard oil. In spoilt turnips, there may have been a part of this liberated substance, but fresh milk rarely has this disagreable taste, which only develops gradually through bacterial influence.

The active bacteria originate either from the water used for washing and rinsing the buckets and vessels, or from cow's dung. The utmost cleanliness should be observed in milking therefore, and if in spite of this the milk has the rape-colewort flavour, a bacteriological examination of the water should be made.

In a test made by the author, it was shown that the bacteria which caused the rape-colewort flavour were liquefying, non-sporing, bacteria, of aqueous origin.

The rape-colewort flavour may also be developed in butter: butter made from sterilised cream and inoculated with these liquefying bacteria, smelt rancid after a time, and after the fat had been removed by filtering, a decided decomposition could be observed.

It is important, therefore, that dairies should have a bacterial examination made of the water they use; if this water contains an appreciable number of liquefying bacteria it must be sterilised before coming into contact with pasteurised cream and butter. P. D.

19. **The Influence of Different Methods of Pasteurisation by Heating on the Digestibility of the Albumenoid and Mineral Constituents of Milk.**

TERROINE, E. F. (Professor at the University and Director of the Institute of General Physiology of the Faculty of Science at Strassburg) and SPINDLER, H. Influence des divers procédé des pasteurisation par chauffage sur la digestibilité des constituants albuminoïdes et minéraux du Lait. *Le Lait,* Year V, No. 43, pp. 241-256, 6 figs. bibliography. Lyons, 1925.

It is important that only milk should be delivered for public consumption which is free from injurious micro-organisms, but its composition and properties at the time of secretion should have been modified as little as possble. These two desiderata appear to be contradictory, for to des-

troy the micro-organisms, the best method is to heat the milk, thus risking modification of its composition, the impairing of its physical structure if not the composition even of its constituents.

The authors have made a comparative study of the influence of low and high temperature pasteurisation, and the STASSANO process.

Cow's milk, sometimes fresh, sometimes subjected to the various processes of pasteurisation under examination, was administered to young pigs of the same age and weight (8-10 kg. when the tests commenced), during the growth period. The quantity of milk given is calculated on the basis of its caloric energy, at the rate of 150 calories per kg. of live weight. The total ration is distributed in three parts, at 8, 13 and 18 o' clock, the milk is heated to 37° C. in a double boiler, and the trough in which it is fed is taken away as soon as the animal has consumed all the milk.

The animals are placed in a special pen which allows the urine and faeces to be removed separately.

In a first series of tests, various animals were compared with one another, and in a second the comparisons were made on the same animal receiving a different milk for each test period, lasting a week.

Every day, both on the milk taken in and on the various portions of faeces collected, the total nitrogen was estimated by the Kjehldahl method, and the ash by incineration in a muffle furnace after desiccation; the results enabled the coefficients of digestibility to be calculated.

Every day a mixed cow's milk was utilised. The first part is given in its natural state; three other portions are treated respectively by one of the following processes:

Low temperature pasteurisation: heating to 63°C. for 25 minutes, with mechanical stirring, then cooling;

High temperature pasteurisation: heating to 95°C. for one or two minutes, then cooling;

STASSANO *process*: heating to 75°C. for 4 ar 5 seconds, the milk flowing out in a thin layer continuously, then cooling.

The results of the tabulated tests enable the following conclusions to be drawn:

(1) Milk, fresh or subjected to heating by the high temperature pasteurisation process, the low, or the STASSANO gave identical coefficients of digestive utilisation of nitrogenous substances and ash.

(2) The values obtained for the coefficients of digestibility of the proteins of cow's milk by the pig are exactly the same as those previously observed by various authors for the digestion of cow's or human milk by children. The specific origin therefore does not entail any difference in digestibility.

(3) Even with a very young animal of rapid growth, feeding with milk alone only allows a poor assimilation of nitrogen: taken at the rate of 150 calories per kg. by young pigs of 8 kgs. weight, the milk only leaves in the organism 50 % of the proteins it contains.

Such method of feeding therefore entails a considerable waste of nitrogen.

P. D.

PLANT DISEASES AND PESTS

Plant Parasites.

20. **The New General Supplement to SACCARDO's *Sylloge Fungorum*.**

SACCARDO P. A. Sylloge Fungorum omnium hucusque cognitorum, Vol. XXIII. Supplementum universale, Part X: *Basidiomycetae*. Curante A. TROTTER (Collab. P. A. and Dominicus SACCARDO, G. B. TRAVERSO, A. TROTTER). One vol., large 8º, XXXII, pp. 1026. Avellino, Pergola, 1925.

Twelve years after the appearance of the last volume of the *Sylloge Fungorum omnium hucusque cognitorum* the continuation has been realised of this very important work for mycological and phytopathological studies, of which the Library of the International Institute of Agriculture has the privilege of holding the copy that P. A. SACCARDO had while living, supplementing it with important printed documents and enriching it with frequent annotations in his own hand.

In fact, through Prof. A. TROTTER, who has added to the material already collected for the purpose by P. A. SACCARDO, in collaboration with Professors D. SACCARDO and G. B. TRAVERSO, the 23rd Volume of the *Sylloge* has now been published. This Volume also forms the tenth part of the *Supplementum universale* to that work, and, as such, includes the diagnosis, made public during the decade 1911-1920, of the Basidiomycetes described in various parts of the world. The fungi discovered in the same decade, but belonging to other taxinomycetic groups, will be registered in Vols. XXIV-XXV of the *Sylloge*, forming respectively parts XI-XII of the *Supplementum universale*, the printing of which will be carried out without delay.

The volume which appeared in 1925 deals with Basidiomycetes, thus classified: *Hymenomycetae* (*Agaricaceae, Polyporaceae, Hydnaceae, Clavariaceae, Thelephoraceae, Tremellaceae*); *Gasteromycetes* (*Phallaceae, Nidulariaceae, Lycoperdaceae, Hymenogastraceae*); *Ustilaginaceae* (*Ustilagineae, Tilletieae*); *Uredineae* (*Pucciniaceae, Melampsoraceae, Cronartiaceae, Coleosporiaceae, Uredinaceae inferiores*).

The total number of species here enumerated is 3314.

The descriptive part of the volume is preceded by a biography of the author of the *Sylloge*, with his portrait and the complete Saccardian bibliography, comprising 238 works, of which 125 are on Mycology, Phytopathology and Cryptogamic nomenclature; the remainder relate to other branches of Botany and the Natural Scuences.

The volume concludes with an index of the fungi described therein, arranged according to their respective hosts, an alphabetical index of the genera and another of the species treated in the volume itself.

G. T.

21. The Effect of X-Rays on "Plant Cancer" (*Bacterium tumefaciens*) and on Normal Plant Growth.

RIVERA V. Il problema del cancro e quello delle infezioni microbiche nel mondo vegetale. *Memorie del Laboratorio di Botanica della R. Università di Bari*, N° 1, 23 pp. Bari, 1925.

Hyperplasiae caused by *Bacterium tumefaciens* on *Pelargonium zonale* and obtained by the author at Bari by inoculating with the agent of " plant cancer " taken from a pure culture, were afterwards subjected by him to the action of the X-Rays. This means has been employed in the investigation of cancer in man and animals of which recent investigators have shown the analogy with " plant cancer ".

The author opens by saying that immediately after a first treatment the growth of the hyperplasiae themselves was stopped, and they soon became smaller until they almost reached vanishing point.

Under the microscope, in the hyperplasiae treated, the cell walls generally in the zone formed of small cells appeared to be torn and disrupted, as though the cells had burst.

The author also observed that, after carrying out the operation in the same conditions as for the *Bact. tumefaciens* test, the action of the X-Rays clearly prevented the normal growth in pots of bean plants, whereas it caused no apparent changes in maize plants contained in the same pot.

G. T.

22. The "Fogging" or "Blackening" of the Leaves of the Sugar-Beet (*Cercospora beticola*) in Italy, during 1924.

MORI G. La Cercospora della barbabietola da zucchero nel 1924. 61 pp., 15 figs. Stabilimento tipo-litografico Marcisi e C., Genoa, 1925.

During 1924, especially in the valley of the Po, the attack of *Cercospora beticola* Sacc. on sugar beet was so serious as to cause very great loss to farmers and sugar manufacturers.

In the above-mentioned area the fungus showed itself as usual about the end of June, became more injurious during the two succeeding months and attacked chiefly the older, outside leaves of the host. Beet plants growing too far apart, and especially isolated plants, were more easily subject to infection and were more damaged.

The attack of the parasite on the leaf was accompanied by other phenomena, such as excessive conical elongation, of the collars (such deformations, more frequent in 1924 than formerly, were specially noticed on sparse and isolated plants) ; formation in the upper part of the root, at the point of insertion of the first leaves, of cavities, sometimes of considerable size ; unusual growth (small roots mixed with large, very large and even monstrous roots, short stumpy roots, very much split up at the base) ; alterations in the arrangement of the tissues of the root and in its sugar content, etc. The experimental observations made in 1924 showed the efficiency for preventive control of the fungus, of the use of copper solutions applied by powerful sprayers.

Such treatment increases the production both in weight and in percentage of sugar. Damage by the parasite may, according to the writer, be reduced :

(1) By increasing the number of the beet plants per square metre.

(2) By avoiding isolated roots and plants ; beets should be uniformly spaced over the ground.

(3) By selecting varieties of beet most resistant to the fungus.

(4) By scientific manuring. G. T.

Animal Parasites.

23. **The Hyphomycete *Spicaria canadensis* n. sp. a Natural Enemy of the Macrolepidoptera *Stilpnotia salicis*, in Canada.**

VUILLEMIN P. A. New Fungus Disease of the Satin Moth Larva. *The Canadian Entomologist ;* Vol. LVII, N°. 4. pp. 97-99, 7 figs. Orillia, 1925.

In Western Canada, and especially in British Columbia, the larvae and chrysalids of the injurious Microlepidopteron *Stilpnotia salicis* L. (1) are attacked by a parasitic hyphomycete which the author considers to be a species new to science and describes under the name of *Spicaria canadensis.* G. T.

24. ***Aphidius* sp., a Parasitic Hymenopteron on the "Black Aphis" of the Peach *(Anuraphis persicae)*, in France.**

GAUTIER Cl. and BONNAMOUR S. Un *Aphidius* (HYM BRACONIDAE) parasite du Puceron du Pêcher. *Bulletin de la Société entemologique de France, N°* 7, p. 127. Paris, 1925.

In three localities of the Rhone Department — at Monplaisir and Saint-Cenis — Laval during 1923, and at Chatillon d'Azergues the following year, the " black aphis " of the peach (*Anuraphis persicae*) which was very abundant, was attacked and almost completely destroyed by a Hymenopteron Braconid parasite not yet definitely determined, but which appears to be very closely related to *Aphidius cardui* Marsh. G. T.

25. ***Argyrophylax inconspicua* and *Masycera sylvatica*, Parasitic Diptera respectively of Lepidoptera *Graëllsia isabellae galliaegloria* and *Celerio Vespertillo*, in France.**

CLEU H. Diptères parasites des chenilles de Graëllsia Galliaegloria Obthr. et de Celerio Vespertilio Esp. *Bulletin de la Société entomologique de France,* N° 7, pp. 126-127. Paris, 1925.

The Diptera *Argyrophylax inconspicua* Meig. (*A. bimaculata* Hartig) and *Masicera sylvatica* Fall. are reported for the first time as parasites respectively of the larvae of *Graëllsia isabellae galliaegloria* Obthr. and *Celerio verspertilio* Esp.

(1) Cf. *R.* May 1921, No. 585, and August 1921 No. 877. (*Ed.*)

Both the Lepidoptera hosts from which the Diptera emerged after breeding, were collected at La Bessee-sur-Durance, the first on the Scotch pine and the second on *Epilobium rosmarinifolium*. G. T.

26. *Elasmognathus* sp., a Rhynchote injurious to the Pepper Plant in Cambodia.

BATHELIER, J. Observations sur un insecte parasite du poivrier. *Bulletin économique de l'Indochine*, New Series, 28th year, No. 170, pp. 62-72, 1 pl. Hanoi, 1925.

The author reports an investigation by him on an insect injurious to pepper plants in the Kampot region of Cambodia. It is a Rhyncote belonging to the family of Tingidides and the *Elasmognathus* Fieber genus, very closely related to *E. nepalensis* Distant, of which it may even be merely a variety. A different species of the same genus is also injurious to the pepper plant in India.

If a pepper plant be examined while in flower, that is in the period from February to October, it will be noticed that the flowers have become covered with *Elasmognathus*, both adults and those in a more or less advanced larval state. The larvae are more numerous than the adults, which seems to indicate that the insect lives longer in the imperfect than in the imago form.

The young and winged individuals of the Rhyncote perforate the peduncles of the flowers, suck the sap and cause the drying of the fruit. The damage thus done is enormous ; the Chinese pepper growers estimate that in spite of the nicotine treatment which they apply, they still lose about $\frac{1}{3}$ of the crop. This Rhyncote is abundant while flowering continues. In October it becomes more and more rare, and during the whole of the dry season only a few active adults are to be found.

As soon as the flowers appear again, in February, individual insects are met with in all stages of development. Their number gradually increases, and from March the maximum quantity is reproduced.

Apparently they deposit their eggs on the flowers themselves ; the flowers constitute their preferred food, and the spread of the species is dependent on the quantity of flowers available. The species survives from year to year through the rare adults which take no food in the absence of flowers, or draw the sap from the leaves which are always available during this time they are apparently unable to reproduce themselves.

The planters use as an insecticide, a decoction of dry tobacco stems and a Cambodian Dioscoracea, the root of which contains an alkaloid allied to strychinine.

The author advises the use of either of the following mixtures :

(1) 3 kg. of syrupy tobacco extract, 4 litres of stick paste (100 gms. of wheat flour per litre), or 3 kg. of soft soap to 130 litres of water ;

(2) 4 kg. of tobacco leaf ribs boiled in 10 litres of water, left to stand for 24 hours, and then strained, 2 kg. of soft soap dissolved in 4 litres of hot water are then added, and the solution diluted to 100 litres.

The treatment consists in spraying sufficiently often to prevent the reproduction of the insects, which, protected by the egg envelope, have escaped the former spraying. The pepper plants therefore should be treated every week.

It would be well to interpolate, between the nicotine sprayings, sprayings with dry substances which also act as contact poisons. These sprayings should be done with sprayers of medium power.

The advantage of these substances is that they penetrate the body of the insect by the open spiracles, which can no longer rid itself of them It perceives the danger only when it is too late for defence.

Only tests methodically carried out could show what insecticide powder has the most energetic action. The author indicates the following as powders which should be tested : pyrethrum, tobacco, and arseniate of lime.

It would be preferable to carry out these dry sprayings before the liquid spraying has completely dried, one day after for instance. The slight moisture then remaining on the leaves would retain a little of the powder without dissolving it, and prevent its being carried off by the wind.

Dried tobacco could be used, ground as finely as possible. This impalpable powder would serve for the dry sprayings, which should be thinly distributed as an almost imperceptible dusting suffices. The coarser residues would be weighed and would serve to make up the mixture of which the formula is given above.

The two applications should be continued at longer intervals, every month for instance, during the dry season. One month before the appearance of the first flowers they should again be made every week, in order to destroy individual insects, which preserve the species during the unfavourable season, and thus to delay their swarming at the moment of flowering. P. C.

27. *Engytatus notatus* and *E. geniculatus*, Rhyncotes injurious to Tobacco in Brazil.

MOREIRA C. Os percevejos capsideos do fumo no Brasil. *Boletim do Ministerio da Agricultura, Industria e Commercio*, Vol. XIII, No. 7, pp. 85-91, 4 fig. Rio de Janeiro, 1925.

Engytatus notatus (Dist.) and *E. geniculatus* Rent., Rhyncotes of the Capsidae family, are two of the most serious enemies of the tobacco plant in Brazil.

These insects collect in great numbers on the host plant, principally on the under sides of the leaves. Their punctures cause damage to the tissue of the leaves, which consequently appear spotted and wither prematurely. In addition, the leaves are disfigured by the excrements which the insects deposit on them, so that the product, even if it does not become quite useless, loses a great deal of its value.

The life of the two Rhyncotes has a total duration of about twenty days, but their generations succeed each other uninterruptedly ; in a short time a whole plantation is infected.

They develop considerably during the hottest and driest time of the year, and decrease in numbers according as the temperature falls and rain becomes more abundant.

Biological observations made regarding *E. notatus* are given; the biology of *E. geniculatus* is almost identical with that of the former species. The writer recommends the protection of the tobacco seedlings against both Rhyncotes by means of cages covered with wire gauge of mesh not larger than one millimetre. After transplanting, the young plants should also be protected until they have attained a height of about thirty centimetres, by means of spraying with emulsions of ordinary hard soap, crude kerosine oil and tobacco extract. The emulsion should not contain more than two per cent. of kerosene oil. With this insecticide a mortality of seventy per cent of the insects sprayed is obtained.

Since the winged insects — more vulnerable than the larvae — hatch out every nine days, the treatment should be repeated every ten days, so as to spray the winged insects, until the parasites are completely destroyed.

The plants treated with the above emulsion, after a few days, especially if rain occurs, will no longer smell of kerosine, so that the author considers that the treatment in question should not be prejudicial to the quality of tobacco. G. T.

28. Observation and Tests regarding the *Tropinota hirta* Coleopteron, Injurious to Grasses and Trees in the Campania. (Italy).

VIGGIANI G. Alcune notizie sulla morfologia e sulla biologia della *Tropinota hirta* con speciale riguardo ai danni da essa recati alle coltivazioni erbacee ed arboree. *Bollettino della Società dei Naturalisti in Napoli*, Vol. XXXVII (ser. II, Vol. XVII), Year XXXIX (1925), pp. 28-53, 2 plates. Naples, 1925.

Results of the observations and tests made from June 1922 to June 1924, regarding the morphology and biology of the adult and larva of the Curculionid *Tropinota hirta* Poda Coleopteron, which have developed in great numbers for some years in vast tracts of the Campania, causing serious injury to the grass and tree crops.

The mouth apparatus of this insect is not typically masticatory; it is adapted to a system of feeding having an essential basis of pollen, which can be licked up without being masticated.

Investigations made on some thousands of flowers belonging to 24 different botanical families — among which should be mentioned Leguminoseae, Rosaceae, Compositae, Crociferae, Mirtaceae, Papaveraceae, Cariophyllaceae, Rutaceae and Graminae — have led the author to the conclusion that the damage caused to the flowers by *Tr. hirta* are generally indirect, i. e. caused by the strong claws and considerable weight of the body of the Coleopteron when in search of pollen and nectar, the direct damage, i. e. the feeding on pollen, being of no importance whatever, from the fact that every anther contains sufficient pollen to fertilise a great number of flowers. The extent of the damage is in close relation to the number of individuals of *Tropinota* present in a given region; the greater or lesser abundance

[28]

of these will cause more or less serious damage to the crops. Plants cultivated for their flowers are generally hindered by an excessively large number of Coleoptera. Neither the direct observations nor the laboratory tests made by the author proved that *Tr. hirta* gnawed especially the pistil of the flowers visited (the broad bean, for instance).

The author observed that the Coleopteron, when it first appears, prefers low ground, whence it passes, as the season is advances, to the hills and mountains ; the insect abounds in regions where the spontaneous flora is rich and cultivation intensive, whereas it is scarce in regions poor in flora and backward in agriculture ; heat is favourable to the development of the larva and still more to the activity of the adult, also to the propagation of the species.

As regards the natural enemies of the Coleopteron in the Campania, some of its pupae have been found invaded by undetermined fungi ; often, under the elitra of *Tr. hirta*, the presence of Acari have been observed, which however do not seem to injure their host.

Up to the present, the most effective artificial means of controlling this insect is to collect the adults, especially when they first make their appearance.

Hedges of hawthorn, clumps of elders, etc., planted all round the fruit ground, by attracting to their flowers the individuals of *Tropinota*, free the fruit trees from the latter ; the same may be said, in the case of sowings of rape, cabbages and mustard planted between the rows. The collecting of the adults should always be done a second time, when there will be found a large number of *Tropinota* massed on a few flowers.

In the author's opinion it is not advisable to spray the flowers with poison solutions or with the ordinary insecticide powders. G. T.

29. *Acrobasis hebescella*, a Microlepidopteron Injurious to the *Hicoria Pecan*, in the United States.

GILL J. B. *United States Department of Agriculture, Department Bulletin* No 1313, pp. 12, figs. 4, Washington D. C., 1925.

The results of a detailed investigation on the biology of *Acrobasis hebescella* Hulst, made at Monticello (Florida). Here, as at Thomasville (Georgia), this Microlepidopteron (fam. Pyralidi) has, for about a decade, caused considerable loss to the growers of " pecan " (*Hicoria Pecan*). The insect, to which has been given the common name of " pecan nut case-borer ", is known to cause serious injury to the same Juglandacea also in other districts of Georgia and in Texas, and has been reported in the States of New Jersey, Illinois, Wisconsin, Connecticut, Mississippi, Louisiana and Alabama, and seems to be gradually extending its sphere of destructive action.

Though both the oak and the pecan have been indicated as host plants of the Microlepidopteron, the author found it only on *H. Pecan*. It may be concluded, however, that it also attacks other species of the genus *Hicoria*

The grubs of *A. hebescella* may also injure both the tender shoots and the immature fruits by boring galleries therein. Those grubs which have

wintered near the bud, attack the young shoots at the beginning of Spring. Many of these, in consequence of such attack, fade and turn brown; others weakened by internal erosion, are broken off by the wind. Such injury, however is not very serious as compared with that caused by the grubs, especially of the first, but also of the second generation, which limit their attacks to the young green fruits.

Having described the various stages of development of the insect and its biology and habits, the author enumerates in the order of their importance the natural enemies obtained, by breeding, from *A. hebescella*. They are: *Exorista (Nemorilla) pyste* Walk., *Habrobracon variabilis* Cush., *Calliephialtes grapholithae* Cress., *Cremastus (Zaleptopygus)* sp. and *Angitia* sp.

The best method of control by artificial means is that of spraying with lead arsenate with the addition of lime solution. Three applications are advised: the first as soon as the fruits have formed; the second, a week or ten days later; the third, four to five weeks after the second spraying. The last may be omitted for economical reasons, but the first two are absolutely necessary.

G. T.

CURRENT NOTICES

Legislative and Administrative Mearures.

30. **France: The Chambers of Agriculture.** — The regulations for the application of the Law of 3 January 1924 on the Chambers of Agriculture were published in the *Journal Officiel* of 26 March 1925.

31. **France: Provisions Guaranteeing the Declaration of Origin of Roquefort Cheese.** — These are contained in a law of 26 July 1925, published in the *Journal Officiel* of 30 July. The denomination "Roquefort" is only to be allowed in the case of cheese which: (*a*) has been prepared and manufactured exclusively with sheep's milk; (*b*) has been manufactured and refined in strict and faithful conformity with local usages, both in regard to the place of production and the method employed. The zone of production of the sheep's milk which enters into the composition of the "Roquefort" naturally remains limited to the centres now existing in France, as well as to those localities in France proper which present the same characteristics as these centres, both as regards breeds of sheep, pasture and climate.

32. **Italy: Measures in regard to the Cultivation of Cereals.** — With the object of encouraging the growing of cereals in Italy to the utmost possible extent, a number of enactments have been issued which taken as a whole make systematic provision for the necessary organisation and the technical and financial requirements in view of the "cereal campaign" (*battaglia del grano*). In the first place a Permanent Committee for Cereals has been set up; and the customs duties on wheat, the minor cereals and their derived products have been re-instituted.

In order to encourage the diffusion of motor ploughing, measures have been passed abolishing the duty on petrol if supplied to a farmer, at a sacrifice of 5,000,000 liras yearly; and increasing to 40,000,000 liras the sum set aside to meet the applications for loans for the purchase of special heavy implements and machinery designed for preparing land for ploughing in areas not previously considered suitable for field crops. In addition, a further allocation of 3,000,000 liras annually has been made for contributions, up to one fourth, towards the expense of purchasing similar appliances and for premiums payable to persons undertaking the breaking up of land.

A further development of the work of the *Cattedre Ambulanti di agricoltura* in the direction of propaganda and technical assistance for cereal cultivation is contemplated and for this purpose the funds allocated to these bodies are

increased by another three million and a half liras, the total allocation thus amounting to 7,000,000 liras. In addition, another 7 million liras are being set aside yearly for the establishment in each commune of the Kingdom, at the State expense, of experimental fields for wheat growing on methods suitable to the district, and a further 4,000,000 are placed each year at the disposal of the Experimental Agricultural Institutes for grain cultivation. Five millions have been assigned to the work of promoting the more general use of selected seeds: the State contributing up to 50 per cent. to the establishment of consortia and associations undertaking the production and the distribution of such seeds.

In addition, Provincial Grain Commissions have been established and have been assigned the funds required for carrying out an intensive propaganda.

Provision is made for loans for working capital, and the agricultural credit institutions, which owe their existence to special laws, have been empowered to expend sufficient funds to carry out an effective propaganda scheme for cereal cultivation, and for this purpose it has been arranged to make loans to the value of 120,000,000 liras.

Steps have also been taken to encourage the construction of grain warehouses, following the procedure as to loans sanctioned by other decree-laws on agricultural land credit. (*Gazzetta Ufficiale*, 18, 24 and 31 July, 8 and 9 August, 1925).

33. **Italy: Enquiry into Cultivation of the Opium Poppy.** — A Committee of the Ministry has been appointed on the proposal of the Department of Public Health for enquiry and for the preparation of the rules under which cultivation of this plant may be carried on.

34. **France (Morocco): Destruction of Caterpillars.** — This is rendered obligatory by the Dahir of 23 May 1925 (*B. O.* No. 660, 16 June 1925).

35. **Mexico: Regulations for the Introduction of Live Stock and Animal Products.** — These are contained in a Decree of 11 May 1925. (*Diario oficial*, 23 May 1925).

36. **Uruguay: Agricultural Legislation.** — The laws, decrees and regulations on the protection of agriculture (*Defensa Agricola*) are under revision for recasting, amplifying or amending as required, now that the service have been amalgamated to form the present Department of Agronomy. This Departement includes the following Sections among others: Development and Protection of Agriculture (*Fomento y Defensa Agricola*); Agricultural Statistical Economy (*Economia Estadistica Agraria*); Information and Education (*Información y Enseñanza*); Forestry Section (*Sección Forestal*); Laboratory (*Laboratorio*).

Experiment Stations and Agricultural Instruction.

37. **Germany: Soil Investigations.** — Research Associations (*Versucheringe*) to the number of more than 300 have been formed in Germany. Their object is twofold: on one hand to give technical advice to the individual holders as to cultivation of their land, on the other to draw conclusions of a general nature from the observations made by individuals Courses of instruction are held for members of these associations. The course

held at Halle in June 1924 dealt with the application of laboratory methods to field experiments; and six lectures with discussion were held respectively on the organisation of field experiments (ROEMER), technical methods in fertiliser tests (MITSCHERLICH), ascertainment of the best adapted species (SCHARNAGEL), seed testing (REMY), on the estimation of results from experiments (OPITZ) and on practical experience (KRAMER).

(*Deutsche Landwirtschafts - Gesellschaft.* Anleitung für Versucheringe. Collezione: "*Anleitungen für den praktischen Landwirt.* One Volume, 16mo of 114 pages. Deutsche Landwirtschafts Gesellschaft, Berlin, 1925).

38. **Germany: Field Experiments.** — T. ROEMER, in a special study, gives an outline of the method of organising field experiments, followed by a historical sketch; in this connection importance attaches to the foundation of the Research Associations under the direction of a qualified agricultural expert. To secure any result, however, the experiments must be carried out with great precision, and the author gives valuable advice on this point. The most interesting part of the book is the discussion of the errors and mistake that may be made in the course of the experiments and so falsify the results: mistakes as to the form of the plots, their situation and size, in the sowings, the gathering of crops, etc. In the working out of the results too it is essential to follow the precise rules of statistical calculation described by the author, who gives in addition practical directions as to the general method. Account has been taken of the important work recently done on this subject by Russian investigators. (ROEMER T. *Der Feldversuch.* Eine kritische Studie auf naturwissenschaftlich- mathematischer Grundlage. Second edition. One volume, octavo, 132 pp. bibliography, one map. *Deutsche Landwirtschafts-Gesellschaft,* Berlin, 1925).

39. **Germany: Sugar-Beet Experiments** — Various German Agricultural Science Institutes have become members of an organization for collective and comparative experiments on the varieties of cultivated beets in Germany, towards which the Ministry of Food and Agriculture has made a grant of 50,000 marks. These institutions included the Institutes of Bornburg, Bonn, Breslau, Halle, Hohenheim, Landsberg and Rostock. The experiments are to include 10 varieties of German beets and seven foreign varieties, but for 1925 it has been decided not to submit to experiment more than nine German and one Dutch variety, as it was too late to obtain from abroad, on favourable terms, seed samples for experimental cultivation.

The experiments are to be continued for a period of about ten years.

40. **Germany: Object Lessons in Plant Pathology by the use of Clay Models.** — Attention is called to the clay modelling work of the German Modelling Society (*Deutsche Hochbild-Gesellschaft*) at Munich, Reinbergerstrasse 5, which has been favourably noticed by all the German technical press (agricultural, special phytopathological and educational journals, etc.). They are executed with greatest possible exactitude and their value and the quality of their execution received recognition at the Educational Exhibition (*Mostra del Materiale Esposizione Didattica Scolastica*), held at Florence in 1925. (Communicated to the International Institute of Agriculture).

41. **Austria: Twenty-fifth Anniversary of the Higher Forestry of Bruck-on-Mur.** — This celebration was held on 25 May 1925. The first move towards the establishment of this Institute dates back to the tenth General Meeting of the Forestry Association of Styria, held on 12 July 1892, Dr. RUDOLF JUGOWIZ formerly professor at the Higher Forestry Institute of Weisskirchen, Moravia was appointed as director at the time of its actual foundation (1900), (*Höhere Forstlehranstalt*) (*Forst- und Jagd-Zeitung*, Year 43, No. 29. Vienna, 1925).

42. **Brazil: Agricultural Experiment and Instruction in the State of Bahia.** — The following particulars of the Experiment Farm at Ondina and the Bahia Agricultural School form part of the "Message" (*Mensagem*) presented to the Legislative Assembly on 7 April 1926 by the Governor of the State of Bahia, Dr. J. DE GOÉS CALMON.

The Ondina experiment and demonstration farm (*Campo de Experiencias e Demonstração*) has carried on work with the object of introducing into Bahia crops not previously known, and giving theoretical and practical instruction in the use of farm machinery. A well equipped meteorological section is attached and a laboratory and museum, under the direction of the entomologist and phytopatologist, Dr. G. BONDAR. This laboratory publishes its own bulletin. As the cultivable area of the experimental farm is too small there is a scheme for enlarging it by acquiring a neighbouring "fazenda" and adapting it for growing hay or fruit, flowers and seeds.

Attention will be given to the further development of the school of agriculture. Although there are 300 hectares of land belonging to the school, it has so far no demonstration farm; it is however to make the proper provision.

The school has a well-arranged library of about 5000 volumes and a well-equipped museum and premises. (*Mensagem apresentada pelo Mxm. Sr.* Dr. FRANCISCO MARQUES DE GOÉS CALMON, *governador do Estado de Bahia a Assembléa Geral Legislativa, por occasião da abertura de la reunião ordinaria da* 18ª *legislatura em 7 de abril de* 1925. Bahia, 1925).

43. **Brazil: The activities of the Experimental Station of Piracicaba.** — A report has been published of the work of the cotton department of this Experimental Station in 1925. Valuable work is carried on in the cultivation of numerous varieties of cotton with a view to selection and specially those which have already been proved to be long staple, and productive types. ("Delphos 6012", "Meado", "Sea Island", "Express", "Webber Delta Type", "Webber 49", "Delphos 631", "Star", "Mebane", "Selecção No. 1",, "Selecção No. 2" "Rowdon"). The plants on the Station are numbered according to the instructions recommended in the United States by the Department of Agriculture.

The report in question refers to various experimental investigations of fertilisers, rotation, etc., carried on at the Station by the Cotton Department. Every precaution has been taken for isolating the different cultivation plots with a view to preventing any spontaneous cross breeding. (*Boletim de Ministerio da Agricultura, Industria e Commercio*).

44. **Brazil: The Museum of the Pomological Station of Deodore.** — A detailed scheme is described for the organization of the Museum of this

important Brazilian Station, containing the following sections: Soil and fertilisers — Plant genetics — Plantation — Irrigation — Pruning — Plant diseases and pests — Fruit picking — Preserving and packing — Industrial products — Photographic records and national and foreign fruit growing. (*Boletim do Ministerio da Agricultura, Industria e Commercio* (a. XIV). Rio de Janeiro, 1925).

45. **Denmark: Organisation of the National Experiment Institute for Plant Cultivation.** — On the occasion of the twenty-fifth year of the foundation of the Danish State Office for plant cultivation, the history of the organisation of this Institute is given by the author. The story goes back to 1860, when the first experiments were undertaken to establish comparisons between manuring with stable manure and with chemical fertilisers. Special prominence is given to the work of P. NIELSEN who up to the age of 27 was working in a factory, and studying to take the elementary teachers' certificate. In his space time he devoted himself to botanical studies and to experiments on plant growing, on seed mixtures for meadows, on plant diseases and arrived at important practical conclusions. He received grants in aid from the State and by degrees his work developed into this institution for practical and scientific research, which takes so important a place in the progress of agriculture in Denmark, and which is so liberally assisted by the State. The list of 172 reports and 106 communications is evidence of the active work of this valuable institution.

(LARSEN H. C. Statens Forsogsvirksomhed i Plantekultur, dens Organisation og Administration. *Tidsskrift for Planteavl*, Vol. 30, Part I, with 62 illustrations and a map. Pfr. R. o. No. 780, 1924).

46. **United States: The Work and Position of the Agricultural Experimental Stations in 1923.** — This information is contained in a complete report published by the Office of Experiment Stations of the U. S. A. Department of Agriculture. Attached to the report is a complete list of the publications issued at the various stations during 1923 (Botany, Chemistry, Bacteriology, Meteorology, Soil, Fertilisers, General agricultural work, Horticulture, Forestry, Phytopathology, Entomology, Zoology, Animal husbandry and periodicals). For the fiscal year 1922-23, 920 in all publications appeared relating to the various branches of agricultural science (E. W. ALLEN, W. H. BEAL and E. R. FLINT, Work and Expenditure of the Agricultural Experiment Stations, 1923. *United States Department of Agriculture, Office of Experiment Station*, Washington, D. C., 1925).

47. **United States: The Arnold Arboretum Library, Jamaica Plain, Mass.** — This institution which is affiliated to Harvard University possesses a specially fine collection of incunabula and generally of early books on systematic botany. The library was begun in 1873 and now contains 35,471 complete volumes and 8000 pamphlets. The collection of Pre-Linnean books (dating from before 1737) contains very valuable bibliographical treasures, including twenty-five books published in the fifteenth century, among which are, APULEIUS PLATONICUS, *Herbarium* (1481 ?); BARBARO, *Castagiones* (1492-93); BARTHOLEMAEUS ANGLICUS, *De proprietatibus rerum* (1480-1491); *Libri de re rustica* (no date); CONRAD von HEGENBERG, *Buch der Natur* (1478); and works of PLINIUS Secundus, THEOPHRASTUS Eresios,

COLUMELLA, LUCRETIUS, VINCENTIUS BELLOVACENSIS, MATTHEUS SYLVATICUS, MACER FLORIDUS, etc.

The periodical section also contains rare editions; among these are DIETRICH'S *Oekonomisch- botanisches Garten Journal* in six volumes (1795-1805) almost unknown in America, the *Annales de l'Institut horticole de Froment* (1829-34); LANDRETH'S *Floral Magazine and Botanical Repository* (1832-34); *L'Horticulteur Belge* in five volumes from 1833-1838, etc.

The collection of publications on conifers contains all the books which are known to have been published about these plants: and it may be added that the collection of conifers in the herbarium is probably the best in the world, only five or six species which grow on the mountains of New Guinea and on the Fiji Islands being now unrepresented.

With the exception of twenty-five volumes written by members of the Staff and published by the Arboretum, this library which is now valued at about $ 1,000,000 has been presented by a few friends of the University. (*Bulletin of Popular Information, Arnold Arboretum, Harvard University*, Jamaica Plain, Mass, 1924).

48. **United States: Analyses of the New York Sugar Trade Laboratory.** — This laboratory has in 1924 analysed 19371 samples of raw sugar which are sold in New York on a polarimetric basis of 96°. The average polarimetric grading of the samples which came to the laboratory was 96.02, that is to say a rate very close to the commercial basis, which points to an improvement in the quality of the raw sugar in comparison with previous years. (*Circulaire hebdomadaire du Comité Central des fabricants de Sucre de France*. Year 37, No. 1834. Paris, 1925).

49. **France: Lectureship in the Veterinary Schools.** — For every subject taught in these schools a group of lectureships has been established open for competition by doctors in veterinary science. The subjects of instruction in these schools may be grouped as follows: chemistry and pharmacy; anatomy; physiology and therapeutics; agricultural science, botany and hygiene, general pathology and pathological anatomy; parasitology, medicine and surgery; animal pathology and obstetrics; microbic diseases and sanitary vigilance; zootechnics; manufacture and inspection of products of animal origin. Only successful candidates in the group competition are admitted to the competition for the full title which is thrown open in the case of any lectureship being vacant. Meantime they assume the title of lecturer and pass on to take actual office each in his own subject as a vacancy occurs on the staff of his own school. (*Journal Officiel*, 31 July 1925).

50. **France: Reestablishment of the Laboratory of Colonial Botany and Agriculture at the Paris Museum.** — In the previous number of this Review mention was made of the fire which destroyed the greater part of the *Laboratoire de Botanique et Agriculture Coloniales* or *Laboratoire d'Agronomie Coloniale*, which is under the direction of the eminent research worker AUGUSTE CHEVALIER. The *Association française pour l'Avancement des Sciences* has sent out an appeal for funds for the replacement so far as possibleof the scientific treasures destroyed by the conflagration. Address, Dr. RIVET Secrétaire du Conseil de l'A. F. S. 28, rue Serpente, Paris IV, France.

51. **Algeria: Agricultural Apprenticeship.** — The Algerian Government with a view to familiarising residents who so desire, with local agricultural practice, decided some time ago to give encouragement to apprenticeship courses on the subjects, making use of the agricultural schools and local experiment stations. Among these institutions is prominent the *Institut Agricole d'Algérie*, at the Maison Carrée (Algiers) or at the *Ferme de Bertaux*, where in addition to the regular instruction with its corresponding equipment (laboratories, collections, libraries, etc.), an Apprenticeship Course is carried on during the winter for drivers of farm machinery (*école d'apprentissage pour mécaniciens-conducteurs agricoles*). This course is worked in connection with the important Rural Engineering Station. Other short courses are held at the *Institut agricole* in enology, grafting and pruning of vines and fruit trees, etc.

The pupils apprentices may be later sent on, when they wish to specialise in some branch of farming, to the institutions affiliated with the *Institut Agricole*, i. e. to the Botanical Station at the Maison Carrée, to the Hamma Experiment Garden, etc. Or they may be accepted at other institutions for agricultural instruction and experiment such as the Philippeville School of Agriculture which has 180 hectares of coast land under cultivation; the School of Agriculture of Sidi Bel Abbé with 195 hectares of plateau in the Oran district; the farm experiment schools of Ain Temouchent in the department of Oran with 500 hectares of field crops; the Guelma Experiment School in the department of Constantine with 100 hectares of cereals, olives, stock rearing, etc.; the Fermo-Branche Station, department of Oran, with cotton cultivation, cultivation of salt lands and fruit-growing); the Orleansville Station, Department of Algeria, where cotton is grown and irrigated crops; the Barral Station, department of Constantine, which specialises in cultivation and preparation of tobacco; the Tadmit pig breeding station in the Southern part of the Department of Algeria; the Stations of Ain Ben Noui and of El Arfiane, in the southern territories of Algeria, where palms grow and are cultivated. (P. CHERVIN. Les Stages agricoles en Algérie. *La Vie Agricole et Rurale*, Year 14, Vol. XXVI, No. 19. Paris 1925).

52. **Great Britain: New Plant Pathological Laboratories at Rothamsted.** — The growing requirements in relation to the study of plant diseases and pests has necessitated further extension of the Rothamsted Station, and in June last, Lord BLEDISLOE, Secretary to the Ministry of Agriculture opened the new and extensive plant pathological laboratories (" *The Times* " June 22, 1925).

53. **Great Britain: Royal Botanic Gardens, Kew, 1924.** — The chief points of interest in the year's work carried on in the Gardens proper, the Herbarium or the Museums and Laboratory have usually been reviewed as part of the information contained in the *Kew Bulletin*, which has appeared since 1887. The main purpose of the Bulletin has always been to supply detailed notes on scientific investigation of economic products and plants, either conducted by the staff or brought under their notice and it has now become impossible to combine with these an adequate account of the general activities of the year. Hence it has been decided to issue this review of the work of the year as a separate Appendix. Some account is given of the improvements effected in the Gardens in the course of 1924; the usual lists of plants

presented and of plants and seeds distributed are included. It has been arranged that some of the exhibits of products from the British Empire Exibition at Wembley are to be housed permanently in the Museums. Highly satisfactory progress has been made with the work in the Herbarium, where a geographical basis is now definitely adopted, so far as possible, for the collections, the interest of the Staff being in this way increased and breadened on ecological and phytogeographical lines. (*Royal Botanic Gardens, Kew; Bulletin of Miscellaneous Information Appendix II*, 1925).

54. **Burma: The Burma Agricultural College and Research Institute, Mandalay,** was opened on December 2nd, 1924, by H. E. the Governor of Burma, Sir SPENCER HARCOURT BUTLER, G. C. I. E., K. C. S. I.

The building is a fine one and contains mycological, botanical, physical, entomological and chemical laboratories, a large museum, and library and reading rooms. The College Farm extends over 600 acres. The College will be affiliated with Rangoon University. (*Agricultural Journal of India*, Vol. XX, Part III, 1925).

55. **Science and Administration in East Africa.** — In the Report of the East African Commission sent out by the British Government, the value of scientific guidance in the development of such countries is recognized. The Amani Institute, founded by Germany in 1902, was visited and the Commission strongly urges that it should be adequately maintained, and considers that the closing of three research farms in Kenya Colony in 1922-1923, on financial grounds, was a most unfortunate step. The Commission further recommends the development of the Nairobi Museum, and draws attention to the urgent need for Government co-operation in education. The adoption of the Commissions proposals would lead to a great advance in scientific research in East Africa. (*Nature*, Vol. 115, No. 2898. London, 1925).

56. **Italy: Experimental Stock Breeding Institute at Rome.** — This Institute was founded in December 1923 and regulations for its complete organisation were issued by Royal Decree, April 1925. The Scientific Headquarters are in Rome and the experimental farm on an Estate of its own and a station for animal prophylaxis has been attached.

The essential objects of the Institute are the study and the solution of the scientific and practical problems which are involved in the rationing, and breeding of livestock with special reference to the stock breeding industry of Central Italy and more particularly of Latium. The Institute is placed under the inspection of the Ministry of National Economy. (*Gazzetta Ufficiale*, 13 May 1925).

57. **Java: Applications of Statistical Method to Experiments in Sugar Cane Cultivation.** — The author, Mr. VAN BREMEN, of the Sugar Experiment Station in Java applies to the enquiry into the production of sugar cane on experimental fields the laws and the formulae of statistical method, so as to ascertain the average error in the reported increases of production. His conclusion is, *inter alia*, that the ascertained profit expressed as a percentage of the lowest of two harvests corresponds to the average percentage error of the products.

VAN BREMEN P. I. (Proefstation voor de Javasuikerindustrie). Samenvattende beverking van de resultaten der proefeldene bij de rietcultur op Java.

Archif voor de suikerindustrie in Nederlandsch Indie, Year 1924, No. 15, pp. 465-475. Soerabaja, 1924.

58. **Peru : New Agricultural Experiment Station.** — A new station has been installed at Chuquibamba at the north of Juliaca and at a height of about 4000 metres above sea-level. The Director is Colonel STORDY. About 18,000 acres of land are attached, with a total head of 15,000 cattle. (*Experiment Station Record*, Vol. 52, No. 9. Washington, D. C., 1925).

59. **Russia : Volga Biological Station.** — By arrangement of the Presidential Bureau of the Saratow Society of Naturalists this Station has just celebrated the 25th Anniversary (1900-1925) of its foundation. The Station is under the direction of A. L. BEHNING.

60. **San Salvador : Agricultural Experiment and Research in the Republic of San Salvador during 1924** — Official data are contained n the " Memoria " presented to the National Legislative Assembly of San Salvador by the Under-Secretary of State Ing. Don MARCOS A. LETONA, on i26 February 1925. Good results have attended the working of the Experiment Stations " La Agronomía " and " Coiba ". The first, situated at Izaloe, has sown cotton, maize and various sorts of vegetables, and in addition is used as a school (*Escuela Mayordomos*). Practical demonstrations are given there of progressive methods of cultivation, the use of modern farm machines, selection of seeds, etc. On " La Coiba " different types of coffee and cotton have been sown and experiments tried with the growing of a variety of plants, among them " Chalmoegra " plants imported from North America. A third Experiment Station is also being organized, the " Zacarius " in the territory of Santa Ana.

The *Ministerio de Agricultura* has had published instructions relating to the sowing of cotton, a guide to the use of chemical fertilisers and has ordered the issue of four volumes of photographic illustrations of the principal plants of San Salvador, duly classified. Studies of livestock diseases have been undertaken and an impetus given to pisciculture. The Chemical Laboratory which is under the direction of Dr. CARLOS BENSON has carried out a large number of analyses of agricultural products and of substances useful to agriculture as well as analyses relating to substances and products connected with other industries. The Entomological Laboratory under the direction of Dr. SALVATOR CALDERON is enlarged by the addition of a Botanical Section which is directly under the Department of Agriculture, and does admirable work in the field of phytopathology, by means of inspection and instruction on special points. (Memoria de los actos del Poder Ejecutivo en los Ramos de Fomento y Agricultura, presentada ante la Honorable Asamblea Nacional Legislativa por el señor Subsecretario do Estado Ing. don MARCOS A. LETONA ; el 26 de febrero de 1925. *Boletin de Fomento y Obras publicas*, Vol. 11, No. 10 and 11. San Salvador 1925).

Agricultural and Scientific Institutions and Associations.

61. **Germany: The Fortieth Anniversary of the German Agricultural Society.** — This occasion was celebrated during the autumn session of this Society (*Deutsche Landwirtschafts-Gesellschaft*) held from 21 to 26 September 1925).

62. **Spain: National Association of Spanish Olive-Growers.** — This Association (*Asociación nacional de Olivareros de España*) was formed on 30 June 1925. It is divided into two sections: olive-growing and olive oil manufacture. Its object is the study of questions of general and local interest relating alike to the cultivation of the olive and the processes of extraction of olive oil and the utilization of the residues of oil manufacture: the diffusion of instruction in the cultivation of olives and the production of oil: the encouragement of the production of olive oil; (shows, competitions, etc.), co-operation (for the distribution of fertilisers, of selected slips, etc.; the institution of demonstration or experimental plantations; the compilation of statistics of olive cultivation or oil manufacture, adequate organization of production, sale, export, etc.: submission to the Government of legislative and fiscal proposals in regard to problems of olive growing; research into and standardization of types of olive oil, information on foreign brands, commercial protection of producers, development of credit, among members of the association, despatch of missions and commercial agents, organization of warehouses and selling agencies purchase of trucks, tanks and other requirements for transport, etc. (From the *Estatutos de la Asociación Nacional de Olivareros de España*, Madrid, 1925).

63. **France, Brittany: The Société Scientifique de Bretagne.** — This Society has been formed with headquarters at Rennes, in connection with the Faculty of Science, with the object of forming links of study and research between all persons living in Brittany who are interested in the various sciences and their applications, encouraging their special work and facilitating the advance of scientific knowledge. The members of the Society receive a Bulletin free consisting of four parts, one for each section of the Society; physical or mathematical sciences, chemical and pharmacological sciences; natural and agronomic sciences; biological and medical sciences. (*Bulletin de la Société Scientifique de Bretagne*, Vol. I, part 1).

64. **Italy: General Inspectorate of Fisheries.** — An *Ispettorato generale per la Pesca* has been instituted by the Minister of National Economy and will deal with the technical and administrative questions relating to this branch of production. Under this head will be included the following among others: stocking of public waters. Examination of the terms of grants or leases of State waters. Investigation of waters as regards breeding of fish or fishing. Technical supervision of the fish-breeding stations or hatching grounds. Experimental fishing squads. Fishing cruises and seasons. Decrees in regard to fishing with mechanical appliances. Inspection of markets Transport of fish. Statistical enquiries on the fishing industry. Subsidiary industries. Reports of the Committee of Marine Soundings (*Comitato Talassografico*) Vocational education of fishermen. (*Gazzetta Ufficiale*, 11 July 1925).

65. **Asia Minor: A Service for Selection of Plants and Seed Testing.** — The Government of the Turkish Republic is organizing in Asia Minor a service on these lines, and meanwhile a Swiss specialist, of the Federal Experiment Station at Lausanne is studying on the spot the means of securing as quickly as possible the improvement of the principal types of crops.

The headquarters of the service will probably be at Angora and Eski-Shehr, but in view of the great climatic diversity of the different regions of

Asia Minor, provision is being made for the formation of several sub-stations in certain localities. During its first years attention will be given to investigation as to the improvement of cereal crops and if possible of tobacco.

The Turkish Government, which is trying in every way to encourage national agriculture and to increase the agricultural yield of Anatolia, has also called upon other specialists for assistance. In this way there are already in existence a station of agricultural chemistry and a service for tropical crops.

Congresses and Conferences.

66. **Belgium: Meeting of the International Committee on Household Management Instruction, Brussells, 16 July 1925.** — This was held on the occasion of the International Exhibition at Laeken. The agenda included: 1. Efficiency methods in town and rural household management; 2. Application of electricity of machinery and other processes for facilitating domestic labour in towns and country districts

67. **Belgium: International Committee on Home Training, Brussells, 17 July 1925.** — Agenda: 1. Extension of the instruction in the elements of Home Training to all classes of society in the different countries; 2. The steps taken and the results obtained for building up the funds required for the development of the International Institute of Home Training.

66. **Belgium: International Committee of Farm Womens' Clubs, Brussells, 18 July 1925.** — Agenda; I. Progress of Farm Women's Clubs in the different countries and suitable methods of encouragement; 2. Proposals for the organisation of an International Congress of Farm womens' Clubs.

69. **France: International Dairying Week at Lyons, 5-12 September 1925.**

70. **Scotland: First Conference of the World Federation of Education Associations, Edinburgh, 20-27 July 1925.** — This Federation was founded in July 1923 at San Francisco (U. S. A.). The subjects discussed at the Conference were: I. The under school age period and kindergartens, 2. Elementary schools; 3. Secondary schools; 4. Character training; 5. Illiterates; 6. The teaching of adults; 7. Training of teachers; 8. Problems of hygiene; 9. The World University; 10. The teaching of history from the international point of view.

71. **Italy: First International Malaria Conference, Rome, 4-6 October 1925.** — Five sections: 1. Anopheles and malaria; 2. Biology of the parasites; single and multiple parasites; 3. Alkaloids and quinine and the therapeutic treatment of malaria; 4. Epidemiological factors and therapeutic treatment of malaria; 5. Propaganda and statistics. The foundation in Italy of an International Institute of malarial studies was discussed and approved.

72. **Rumania: Sixth International Chemistry Congress, Bucarest 22-25 June 1925.** — This was held under the Chairmanship of Sir WILLIAM POPE, F. R. S., Professor of Cambridge University and President of the International Union of Pure and Applied Chemistry. Eighteen nations took part in the Conference: an important resolution was passed in reference to the

International Research Council (*Conseil International de Recherches*). Unanimous approval was given to the resolution inserted, by request of the Copenhagen Conference, in the agenda of the Bucarest meeting. This resolution recognises that it would be advantageous for the International Research Council so to amend its rules that any country on becoming a member of the League of Nations should be admitted to membership of Unions affiliated to the International Council. Amongst various technical questions discussed, Professor F. GIORDANI of the Naples Polytechnic dealt with the problem of nitrogen. A desire was expressed on behalf of the Belgian delegates that the Union would study improved methods of preservation of paper and ink and Rumania expressed the wish that the Union would take up the question of agricultural chemistry. It was decided that these two last questions should be considered by the sections concerned of the Consultative Committee of the Union on which a certain number of nations are already represented. Professor E. FOURNEAU (France) member of the *Académie de Médecine* and Director of the Pasteur Institute dealt with the relations between the chemical composition of bodies and their physiological properties.

In regard to the headquartes of the next Conference the invitation of the American Delegate was accepted to hold the Conference at Washington in September 1926. This is the more appropriate as the United States are then to commemorate the 150th anniversary of their Independence and the American Chemical Society the 50th anniversary of its foundation.

73. **Poland : XII International Congress of Agriculture, Warsaw, 21-24 June 1925** — As a continuation of the notice of this Congress appearing in an earlier number (Vol. III, 3) some account may be given of the resolutions adopted by those Sections which discussed subjects of more general importance, and more closely connected with the scope of this Review, viz. the problems of the rural industries and of agricultural instruction. In the next number, some detail will be inserted as to the subjects of technical importance handled by the Congress.

Section IV. *Agricultural Industries.* — 1. The Congress recognises that the guiding policy should be that of inducing agriculturists, small and large, to prepare their own products, and to secure the sale, and that it is therefore necessary to consider : (*a*) the formation of producers' unions and the due establishment by these unions of the funds required for the transformation of the existing organisations into co-operative societies or profit-sharing associations ; (*b*) the training of the experts who are required to manage these societies and to ensure their progress. In the meantime while waiting for the complete realisation of this scheme, an undertaking should be obtained from the manufacturers who transform agricultural products that once the cost price, either of the raw material, or of the process, is covered, the profits or losses shall be charged proportionately to the capital invested in the production or transformation of a single unit of produce.

2. In view of the importance of the industrialisation of agriculture and especially of industrialisation based on co-operation, it is recommended that information relating to the type of management, the form of organization and the financial results obtained in co-operative societies of the purely industrial type as well as in co-operative agricultural societies for purchase and

sale, should be collected throughout the world and published under the form of a special report by the International Institute of Agriculture.

3. With the object of developing agricultural production, the industrial use of alcohol should be intensified in every possible way.

In addition Section IV approved the following conclusions with reference to the cultivation of beet root-sugar.

A Permanent Office of Sugar-beet Growers should be set up at the International Institute of Agriculture; competitions should be arranged in regard to the implements required for the mechanical labour used in the cultivation of sugar-beet: an International Commission of Sugar-beet Growers should be formed for the study of methods of organisation of work and for propaganda in favour of the consumption of beet sugar; the tendency to apply agricultural principles to the sugar industry should be strengthened, the application varying in each country in respect of form; steps should be taken in the different countries to safeguard beet cultivation and the beet sugar industry.

Section V. *Agricultural Instruction.* — As regards the diffusion of agricultural knowledge among the mass of the rural population, a resolution was passed for the collaboration, both in respect of organization and finance, of the Governments, the Chambers of Agriculture, the agricultural associations, etc. The practical work in connection with this will devolve upon the associations with rural bias, e. g. farmers' clubs, farmwomens' clubs, etc., these latter to be formed wherever required. The instruction should be supplemented by lectures suited to the different localities; by visits to experiment stations, farms, etc.; excursions and practical demonstrations, the organization of farm apprenticeships, suitable literature libraries, etc. The propaganda for agricultural education must without exception be conducted on lines parallel to the organisation and advance of agriculture; further, in view of the importance of womens' work in the country, a special section should be instituted at all future congresses for the study of problems relating to rural housewifery.

The problem of agricultural instruction among the masses was then considered from the point of view of general education given with a rural bias and so arranged as to exercise a valuable influence on the development and improvement of the general conditions of rural life. Primary education should be so designed as to encourage a strong feeling for the country side, and with a view to making the school work more instructive and recreative, practical work and excursions should be multiplied, while every rural primary school should have its demonstration garden and its natural history collections. The training college courses must in their turn be adapted to form the character of the teacher to impart a love of the country, the development of resource fulness in adapting instruction to local needs, and an interest in taking a share in the improvement of the agricultural and social conditions of the district.

As regards the organisation of farm apprenticeship, the Congress has finally resolved that the managing heads of the lower and middle agricultural schools should themselves direct the apprenticeship courses of their pupils, and the lecturer in the higher schools should assist in the drawing up of the scheme of apprenticeship.

The apprenticeships, should cover at least the periods of the more im-

portant field work and for that purpose full advantage should be taken of the winter, spring and autumn vacations. Those who do not intend to specialise should complete their practice on farms which are well managed and of high yield. The object of apprenticeship which is coincident with a course of study is to initiate the apprentices into manual work, agricultural work in general and organisation of work. In this way the knowledge acquired in theory is deepened and skill in management of the farm is attained.

An international exchange of apprentices with visits to wellknown farm undertakings and establishments for special forms of production might be organised on a large scale. (Received by the Institute from the Secretariat of the Organising Committee of the Congress).

74. **Switzerland : International Congress on Agriculture. Davos August 1925.**

75. **Germany : Fourth General Meeting of the Colloid Associations (Kolloid-Gesellschaft). Nuremberg, 5-7 September 1925.** — This meeting was held immediately after the fourth general meeting of the Society of German Chemists, (*Verein Deutscher Chemiker*). The principal subject of discussion was experimental methods of Colloid Chemistry.

76. **France : Congress of the Scientific Societies of Burgundy, Auxerre, 5-7 June 1925.** — The agenda included in the scientific section agricultural and botanical maping.

77. **Flanders Hop Week. Hazelbrouck, 4-12 October 1925.** — This was held on the occasion of the Flanders Hop Competition, organised by the Hop Cultivators? Union.

78. **Italy : Second Conference of South Italian Agriculturalists, Rome, 29-30 June 1925.** — This Conference was summoned by the Organising Committee of the Consortia of land improvement for Southern Italy and the Islands. Subjects discussed : Avv. A. MARTINI : Land improvements of Calabria ; Avv. D. S. CECI : The Improvement of the Tableland of Apulia in certain technical and legislative respects ; Prof. E. CONGEDO : The work of the Co-operative Societies in connection with the carrying out of improvement schemes ; Cav. D. LACAVA : The work of the Committee ; Legislation for control of Malaria ; Ing. R. CURATO : Irrigation in the South of Italy from the technical and economic point of view : Prof. C. CIMINO : Defects and omissions in the land improvement and agricultural credit legislation with referencedo Southern Italy ; Prof. G. SCALISE : Needs of Southern Italy and their financies ; Dr. L. FANO : Land improvement legislation and the work of the Consortia ; A. MAZZOTTO : The Improvement of agricultural land ; Dr. A. RIZZO : The improvements in the provinces.

79. **Italy : Conference of the Lombard Silk Worm Breeding Agricultural Institutions. Milan, 11 July 1925.**

80, **Italy : First National Congress of Importers and Exporters, Milan, 5-6 December 1925.**

Exhibitions, Fairs and Competitions.

81. **Austria : International Agricultural Exhibition. Vienna, 6-13 September 1925.**

82. **Great Britain : 7th International Tobacco Exhibition, London, 9-16 May 1925.** — Organized by the London Tabacco Associations. Eight nations represented : Czeco-Slovakia. Cuba, Egypt, Greece, Italy, Holland, United States, Turkey.

83. **Switzerland : International Exhibition of Inland Navigation and of the Exploitation of Hydraulic Power, Basel, 1 July-15 September 1926.** — The exhibition will be held on the occasion of the inauguration of the new Rhine Port installations, as initiated by the city of Basel.

84. **The 32nd Travelling Exibition of the German Agricultural Society (D. L. G.)** — This exhibition will be held in Breslau (Silesia) from 31 May to 6 June 1926. Special trains at reduced fares will be run in connection with the Breslau Travelling Exhibition from 31 May to 6 June for societies and members of agricultural authorities. A reduction of 35 per cent. will be made on the ordinary fares. Tickets for the special trains for the members of agriculturel authorities will be sold by the State Railway Company up to two days before the dates on which the trains are advertised to run. In the case of the sale of an insufficient number of tickets only, the train will be cancelled. Passengers will probably be able to return frem Breslau by any of the ordinary trains. Requests for special trains should be addressed without delay by agricultural authorities to the offices of the Society, Berlin S. W. 11. Dessauerstrasse 14.

The reduction for societies, when the party consists of less than 30 members, is 25 % for second, third and fourth class tickets. Schools of Agriculture, High schools, etc., may obtain a 50 % reduction for a party of at least ten persons.

85. **Germany : National Exhibition of " German wine " (" Deutscher Wein "), Coblenz, 8 August-13 September 1925.**

86. **Germany : Twentieth Brewery Exhibition, Berlin, 5-13 October 1925.** — This was held on the occasion of the Autumn meeting of the Experimental Brewing Institute at Berlin (*Versuchs-und Lehranstalt für Brauerei*) and it coincided in time with the XXII Exhibition of Barleys and Hops. Particulars may be had from : *Institute für Garungsgewerbe*, Seestr, 12-15 Berlin *n°* 65.

87. **Austria : Sample Fair, Innsbruck, 4-11 October 1925.**

88. **Austria : Second Brown Swiss Breed Bulls Fair, S. Michele near Leoben, Styria, 20 September 1925.**

89. **Egypt : Agricultural and Industrial Exhibition, Cairo, 20 February-6 March 1926.** — *Agricultural Section* : 1. Agricultural products ; 2. Agricultural industries. 3. Live stock ; 4. Poultry ; 5. Stock Hygiene ; 6. Agriculture ; 7. Fruit ; 8. Sericulture. *Industrial Section* : 1 Motor machinery ; 2. Farm implements etc. ; 3. Transport equipment ; 4. Textile products ; 5. Furniture ; 6. Rural buildings.

90. **United States : Cattle Show, Portland, 31 October-5 November 1925.**

91. **United States : Petroleum Exhibition, Tulsa, 1-10 October 1925.**

92. **France : Olive Oil Exhibition, Lyons, 5-12 November 1925.** — Five sections : Olive oil ; Preserved olives ; By-products ; Packing materials ; Machinery.

93. **Italy : Electro-cultivation Exhibition, Milan, 12-27 April 1926.** — The exhibition will include : 1) a section for special electric machinery movable transforming huts, transportable motors, etc.) ; 2) a section for farm machines of various kinds driven by electric power ; 3) a ploughing demonstration ; 4) an exhibition of miniature models, of drawings and photographs of reclamation works, irrigation, etc., carried out by electrical methods ; 5. cinema films showing machinery which is too heavy to be transported to the exhibition.

94. **Italy: Grain and Peach Show, Verona. 9-12 August 1925.**

95. **Italy: Stock Show, Como, 1-2 September 1925.**

96. **Rumania : Sample Fair, Chisinau, 15-30 September 1925.**

97. **Switzerland : Brown Swiss Breed Bull Fair, Zug, 2-4 September 1925.** — Organised by the Swiss Federation of the Consortia for Brown Swiss Breed

Development of Agriculture in Various Countries.

98. **Austria: Agrarian Reform.** — Under this title (*Die Agrarreform Oesterreichs*) Dr. HERMANN KALLBRUNNER of Vienna has published an exhaustive critical article, dealing with the subject especially from the legislative point of view (*Berichte über Landwirtschaft*, published by the German *Reichsministerium für Ernahrung und Landwirtschaft*, New Series, Vol. III, Part I, pp. 124-136. Berlin, 1925).

99. **Florida and Rubber Production.** — — At the present time the United States utilise 75 % of the world's total production of rubber, but produce only 2 % and the United States rubber interests have studied Florida as a rubber producing State. The average yield of plantations in the East is about 300 lb. per acre, at which rate 2,725,300 acres would be needed to supply the United States' requirements. The climate is satisfactory and an area of over 5,000,000 acres has been found which is considered to be suitable when drained. The cost of labour in Florida would prevent profitable cultivation of Hevea unless other methods of latex extraction can be discovered, but this drawback may not apply to other types of rubber plants, from which the latex may be extracted by mechanical methods. Extensive experiments are being carried out. (*India Rubber World*, Vol. LXXII, No. 3, 1925).

100. **United States to grow Rubber in Liberia.** — American rubber interests have negotiated for an extensive tract of land (about 1,000,000 acres) in Liberia for growing plantation rubber on a large scale. It is expected that yields of crude rubber will be available in five years. (*The India Rubber World*, Vol. LXXII, No. 5, New York, 1925).

101. **Crop Production in India:** A critical survey of its problems, by A. HOWARD, C. I. E., Director of the Agricultural Experiment Institute, Indore Central India (pp. 200, 10*s*. 6*d*, Oxford University Press, London). (« *Nature* », July 4, 1925).

102. **Rumania : State Co-operation in the Improvement of the Cultivation of the Expropriated Lands.** — An article appears on this subject in the *Buletinul Agriculturei*. The author first expresses some general views on the agrarian reform in Rumania, giving statistics of the appropriation and

division of the land. He then reviews the measures taken by the Rumanian Government for a rapid improvement of agricultural production. On the completion of the agrarian reform, the confusion introduced into the cropping of the following year was such as to reduce considerably both the cultivated area and the quality of the products, thus showing that the peasant cultivation did not fully meet the requirements of the time and of the country. The State immediately introduced measures calculated to systematize and improve production while at the same time exerting a direct influence on peasant cultivation. Factories were put up, nurseries made and centres of scientific agriculture were established according to modern principles. At the same time the *Casa Centrale a Improprietarirsi* (Central Bank of Landowners) by means of the *Centrala Obstiilor Satesti* undertook extensive propaganda work with a view to grouping the peasants in agricultural co-operative societies through which farmers are to be supplied with agricultural machinery, utensils, etc., and which at the same time secure the sale of the produce of members. Hence in the former kingdom there came into existence 315 agricultural co-operative societies with 19,270,586 lei of subscribed capital, and 16,835 members and a paid up capital of 3,917,613. In Bessarabia 476 agricultural co-operative societies were constituted with 27,156 members and 7,736,786 lei or subscribed and 1,064,355 paid up capital. In Bessarabia, following on the winding up of the "*Casa Noastra*" another 20 agricultural co-operative societies were instituted with 1748 members, subscribed capital of 759,570, and paid up capital of 141,896 lei. In Ardeal the old type of co-operative societies were by degrees transformed into co-operative societies of the type existing in the former Kingdom, the whole agricultural co-operative movement thus becoming homogenous In Bukovina co-operation is still in early stages. In addition to these measures and the grant of one million lei for addition to the livestock, the State has organized district exhibitions as a means of supervising and stimulating agricultural producers. In February 1924 the Congress of the Societies of Agricultural Experts drew up a complete programme of new practical measures based strongly on government support, which are being carried into effect at the present time. (*Chitoiu D. C.* Agrarian Reform in Rumania, *Buletinul Agriculturei*, Vol. IV, 1924, October-December, No. 10-12. Bucarest).

103. **Rumania: Settlements in Transylvania.** — The policy adopted by the Rumanian Government of transferring part of the population of the mountain districts to the extensive, thinly populated areas of Western Transylvania, is being carried out in acordance with economic principles, the settlers being accomodated in new villages.

The success of these settlements largely depends on the extent to which the State is prepared to assist the settlers (CIOMAC L. I. "Colonizarile din Transilvania" *Viata Agricola*, Year XVI, No. 5, pag. 141-143. Bucarest 1 March 1925).

104. **Rumania : Assistance to Agriculture in Bessarabia.** — VERSCOGLI, writing in *Viata Agricola*, a Rumanian periodical, gives a vivid description of the deplorable state of the orchards, which are ravaged by parasites, of fields overrun with weeds, and of the utter ignorance of the peasants as regards rotation of crops and modern methods of cultivation. The writer

suggests, as likely to benefit cultivation in Bessarabia, organization on the following lines:

1. Model gardens and experimental fields;

2. Depots for the distribution of seeds, insecticides and agricultural machines to the population, at cost price;

3. Plots for the production of selected seeds, utilising for this purpose the allotments so assigned under the agrarian reform;

4. Seed-testing stations and selection farms;

5. Inspection of plant nurseries;

6. Higher schools of agriculture; the issue of leaflets on farming subjects intended for the agricultural classes; courses on all the various branches of agriculture.

Miscellaneous.

105. **Brazil: Rural Welfare Work.** — The following information of the health measures undertaken in the rural districts is taken from an article by Dr. R. D'ALMEIDA MAGALHAES, General Secretary of the National Department of Public Health in Brazil. This form of welfare work was begun in 1917, when prophylaxis was first introduced. With the formation of the Department, sanitary organisation on definite lines was undertaken. In 17 States, this work is in the hands of expert officers of the Federal Government, who collaborate with the authorities in each State, expenses being shared by the Central Government and the government of each State. The offices of the service are situated in the various State capitals, and from these centres superintendence is effected of the country town dispensaries, many of which further by all means in their power the increased use of prophylactic measures. With this co-operation on the part of the country towns, an efficient health organisation is being gradually formed, which has already done good work in combatting the two serious endemic diseases of the Brazilian rural districts, anchylostomiasis and malaria, the methods followed being actual medical treatment of the sufferers and the installation of drainage works on a small scale.

District hospitals have been established in some States. (Dr. R. d'ALMEIDA MAGALHAES. Progreso Sanitario do Brasil. *Boletin Commercial do Brasil* year IV, No. 25. Rio de Janeiro, 1925).

106. **Brazil Forest Reserves.** — J. REZENDE SILVA in the *Boletin do Ministerio da Agricultura, Industria e Commercio* (Year XIV, No. 6, Rio de Janeiro, 1925) discusses the organisation of the forest service of the Republic in reference to the Decree of 28 December 1921 by which the Service was instituted. The writer enumerates the various types of lands which could be utilised by the Federal Government for purposes of re-afforestation, and expresses the opinion that the Ministry of Agriculture, Industry and Commerce should direct that a detailed report should be prepared, giving full particulars relating to area, location, nature, etc., of all the Federal lands. On the basis of this report for which the assistance of the various departments and officials would be required throughout the Republic, it would be possible to prepare a map of these areas.

107. **Denmark: Fruit Storage Experiments.** — Experiments in the storage of apples and pears were begun in 1918 at Blangsted (Denmark) in a building erected in 1917 and consisting of an ordinary cellar and a cold storage plant of fruit. Comparisons were made between storage of apples and pears in cellars and in cold storage rooms at temperatures of 4.5, 3.5, 2.5, 1.5, 0.5° C. Other experiments were carried out in cellars and cold storage rooms which were (*a*) unventilated, (*b*) ventilated, (*c*) with the addition of ozone.

The main results were as follows:

The keeping power of fruit varies greatly from year to year. All varieties of apples and pears kept much longer in a cold storage room than in a cellar. During the winter months, after removal from cold storage, fruit kept fresh for at least two weeks, with the exception of the variety Nouveau Poiteau, in which core rot was found. The flavour of apples does not seem to be affected by the temperatures or duration of storage. Pears picked before they are ripe do not obtain a good flavour when ripened at a low temperature. Some varieties lose flavour under protracted storage. Ventilation with outer air or the generation of ozone, does not seem to increase the keeping power of fruit. Scabby fruit does not keep as well as sound fruit. Wrapping the fruit in tissue paper seems to have no preservative effect, but generally enhances its beauty. Fine, dry, powdered peat as a packing material increases the keeping power of fruit by one month or more. Large fruits do not keep as well as smaller ones from the same tree. (*Ice and Cold Storage*, Vol. XXVII, No. 317, London 1924).

108. **Egypt: Agricultural Films.** — In an article in the *Bulletin de l'Union des Agriculteurs d'Égypte,* PIERRE ICHAC, Ing. Agr. draws attention to the advantage which Egyptian agriculture would derive from a use of the cinema, on lines similar to those followed with successful results in many European and American countries. The writer points out that throughout the valley of the Nile lectures could be given accompanied with films, the necessary apparatus being transported on lorries. These lectures would deal with purely agricultural matters and with such rudimentary principles of hygiene and local prophylaxis as may be of practical use to the fellah. (P. ICHAC Le Cinéma au service de l'agriculture. (*Bull. Un. Agr. d'Égypte*, Year 35, No. 162, Cairo, 1925).

109. **United States: Agricultural Films** — The Department of Agriculture of the United States has published an interesting circular in the form of a leaflet from which may be gathered abundant data on the agricultural propaganda in these States carried on by means of films. An explanation is given of the methods of distribution of the films and of the way to apply for their loan. The individual or organization asking for them is expected to pay only the postage or transport expenses both ways. The application must be addressed to the *Office of Motion Pictures* ; *Extension Service, United States Department of Agriculture, Washington D. C.*, Copies of the films may also be bought at prices already fixed, and the conditions governing such purchases are that no changes are to be made in the subject matter of the films without approval from the department and that no commercial or advertising matter be added to or inserted in the film. Titles in foreign languages, if desired, may be obtained at additional cost.

A catalogue of the films of the Department is added. The titles are arranged by subjects and reference is made in each case to the special Department (Bureau of Animal Industry, Bureau of Dairying, Bureau of Entomology, Bureau of Plant Industry, etc.). The films thus treat of farm animals, (cattle, horses, sheep, swine, fowls): wild animals, crops, rural engineering, forestry, entomology, trade in agricultural products, rural organization (Motion Pictures, of the United States Department of Agriculture, *Miscellaneous Circular* No. 27. Washington, 1924).

110. **Fisheries in the Antilles.** — A number of American scientific Institutes have decided to contribute 100,000 dollars for the organization of a mission which is to make deep sea soundings and to examine the possibilities of fisheries in the waters of the Antilles. (*Revue générale du Froid et des industries frigorifiques*, Year 6, No. 8. Paris, 1925).

111. **United States: Discovery of Potash Deposits in Texas.** — The Geological Survey of the United States has recently discovered extensive potash beds in Texas. The mineral is in the form of polyhalite, analyses from borings giving from 4 to 11.21 % K_2O.

The tract of country in which potash has been found is about 275 miles by 125 miles, but data are not yet sufficient on which to base accurate estimations as to area or value; geologists are of the opinion, however, that the beds will be found to be of large extent (*American Forests*, Vol. 31, No. 375, Washington, D. C., 1925).

112. **Forest Fires.** — Ing. F. MICHETTE, president of the *Institut de la Science du Feu* has recently published a critical study on the subject of forest fires. The writer discusses the theories held as to the outbreaks of fire among growing trees or plants and the methods adopted for extinguishing such fires. After a clear exposition of the various conflicting views, he rejects the majority and comes to the conclusion that forest fires are caused solely by spontaneous combustion. This being the case, the only effective means of checking the fire, once it has broken out, would be the removal of the forest litter. The writer deals exhaustively with the practical and theoretical aspects of the problem and the methods adopted to prevent and check these conflagrations. (FÉLICIEN MENOTTE, Étude sur les incendies de forêts. *Institut de la Science du Feu*, pp. 64, 8vo. Paris, 1925).

113. **Report of British Cotton Growing Association,** presented at Manchester, June 12, 1925. The following information is contained in the Report: In India, sufficient seed of American types of cotton was distributed in the Punjab last season to plant 100,000 acres. The output of Uganda amounted to 126,600 bales, valued at L.3,500,000. Tanganyika exported 17,500 bales. The Soudan produced 46,000 bales and the land is ready for planting 100,000 acres in the Makwar Dam area. The output of Iraq was 2,500 bales, a considerable increase, but production is limited by lack of irrigation and salinity of the soil due to absence of drainage. The estimate for Queensland for the present year is 17,000 bales. Excluding India, the total output for the British Empire for 1924 is 261,900 bales, as compared with 179,500 bales in 1923. By December 1926 it is estimated that the total will reach 500,000 bales.

114. **Africa : Reclamation Schemes in the Sahara.** — The French Academy of Colonial Sciences (*Académie des Sciences Coloniales*) has opened a competition for 1925-26 on the subject of the Sahara. Competitors are required to discuss the following particulars : 1. Scientific data ; 2. Technical procedure ; 3. Stages of the work ; 4. Financial measures ; 5. Future prospects. The competition closes on 1 October 1926. The winner will be awarded a prize of 12,000 francs. Two or more writers can be allowed to collaborate. Enquiries : *Académie des Sciences Coloniales*, rue Mayet, 16-bis, Paris (VIe).

115. **Shirley Institute Memoirs**, Vol. 3, 1924, pp. 362. (British Cotton Industry Rese rch Association, Manchester). The volume includes twenty-seven original papers in cotton research and contains an excellent summary of the literature on the action of light on dyes applied to cotton fabrics. (" *Nature* " August, 1, 1925).

116. **Scotland : Experimental Sugar Beet Cultivation.** — According to the report of the Commission appointed by the Scottish Board of Agriculture to ascertain whether the beet sugar industry could be successfully introduced into Scotland, experiments carried out in beet cultivation in various parts of Scotland, including the northern counties of Aberdeen, Moray. Nairn and Banff have given satisfactory results. The Commission is of opinion however that further investigation is necessary, while farmers should be properly acquainted with the methods of cultivation required before the scheme can be entertained as a profitable commercial proposition. Experiments must also be made to ascertain the most suitable time for sowing. *Circulaire hebdomadaire du Comité Central des fabricants de Sucre de France.* Year 37, No. 1893. Paris 1925).

117. **Australia : Refrigerated Fruit Transport.** — At a recent meeting of the Australian Fruit Council a committee was appointed to draw up a report dealing with scientific research on the transport of fresh fruit. It was proposed that the separate sections of technical research undertaken in the various States should be co-ordinated, preferably in co-operation with the University of Cambridge. It was suggested that the subject of fruit transport be divided into three main sections : (*a*) the fruit ; (*b*) the ships' hold ; (*c*) co-operation between producer and ship's engineer. The cost of the work to be shared proportionally by the Governments concerned. It is anticipated that the work could be carried out in about three years. (*The Fruit World of Australasia*, Vol. XXVI, No. 6. Melbourne, 1925).

118. **South Africa : A Successful Co-operative Cotton Ginnery.** — The author gives a brief account of the history of cotton ginning, and the advantages to be derived from co-operation in this industry, especially as regards standardisation of the product. The Barberton Cotton Co-operative Company, formed in 1923, and its work is then described, and a summary of the regulations is given, which should be of interest to growers farming similar societies.

The following advice is given to growers : It is cheaper and more satisfactory to gin cotton which has been pooled according to grade, type and staple, as the gins can then make long runs on one grade. If a grower sends four grades for separate ginning, the gin will have to start four times, for short runs. This means extra supervision, and the advantages of a large, modern

equipment are entirely lost. Growers are advised to pool their cotton, and to state merely whether their cotton is to be sold in South Africa or on the European markets. (*Journal of the Department of Agriculture, Union of South Africa*, Vol. IX, No. 5, 1924).

119. **Sugar in Kenya.** — British East Africa — now Kenya Colony and Protectorate — was until 1920 virgin soil from the point of view of the sugar industry. For many years cane had been grown by both natives and Indians for their own consumption and the manufacture of a crude molasses sugar known as "jaggery". As with all sugar territories, molasses sugar has paved the way for its successor, the centrifugal product.

In 1920 a valuable tract of 10,000 acres was secured by a commercial company, in the famous Kavirondo Valley, bordering on the native reserve and situated 570 miles from the Coast, while 18 miles further inland is Kisumu, Kenya's present terminus of the Uganda Railway on the shores of Victoria Nyanza. The altitude of the estate is approximately 4000 feet above sea level and it is about 4 miles south of the equator.

The Kavirondo Valley is really a speck in the Great Rift Valley which cuts Africa in half longitudinally. Its dimensions are approximately 60 miles by 35, a good deal larger than the island of Mauritius, where 250,000 tons of sugar are produced per annum. This valley is an exceedingly fertile area inhabited by and reserved for the Kavirondo tribe, who number about 1,000,000. The soil, an accumulation of centuries of silt washings from the surrounding ranges, varies from a red decomposed granite on the slopes to a rich, loose, black cotton loam on the plains. Practically the whole area is well watered by countless small streams from the enclosing mountains. There are also possibilities of irrigation from Victoria Nyanza and the day no doubt will come when the waters of the world's largest fresh water lake will be harnessed for power and agriculture throughout the valley. A dry climate, with an average yearly rainfall of 45 inches, will make white settlement a lucrative agricultural proposition.

The labour question to-day is probably without parallel in any part of the world. The Kavirondo is docile and tractable and his shortcomings in energy are balanced by his low wage of ten shillings per month, with a food ration of maize meal.

The Victoria Nyanza Sugar Company actually commenced operations in 1921, and planted a drought-resisting cane known as "Uba", probably of East Indian origin. Subsequent propagation of various canes from Australia and Java, together with the Central African native cane "Kampala", is proving successful, though, as yet, Uba is responsible for 90 % of the crop.

Maturity is reached after 20 months and a short experience of plant and ratoon crops indicates that a 20 ton crop per acre, averaging over the 2nd ratoon, may reasonably be anticipated. Uba is a hardy cane of 15 % fibre and approximately 13.7 % sucrose, and contains an excess of gums and reducing sugars which make its milling and white sugar extraction a matter of greater difficulty than is the case with the softer canes of other countries.

The Company possesses (1924) a modern 14 roller mill and with an output of 25 tons per hour. A good class of plantation white sugar is being turned out for local consumption and East African export.

New ground has been broken and further developments are in prospect as there is little doubt that Kenya offers excellent prospects as a sugar producing country. (Comunicated by Mr. G. R. MAYERS *Managing Director, Victoria Nyanza Sugar Company*).

Since receipt of the above, the 1924-25 *Report* of the Company has appeared and shows that, during that period 20 073 tons of cane where treated and 1385 tons of sugar manufactured. The total area planted is 3876 acres. (*Ed.*)

120. **History of Literature on Cheese-making.** — According to a carefully written article by Prof. COSTANTINO GORINI, with an ample list of references, the first reliable writings dealing with cheese-making appeared in 1834, in the form of essays sent to the International Competition held by the Royal Institute of Science, Literature and Art (*I. R. Istituto di Scienze, Lettere ed Arti*) of the Lombard-Venetian kingdom in 1834. The competitors were required to send a paper on "subjects closely connected with the improment of cheese, with a view to establishing certain definite methods of improving the quality of cheese and increasing the quantity produced", an exacting task, as GORINI remarks. As a result of this competition, in which seven competitors took part, two studies were published: one by L. PELLEGRINI, doctor of medicine and professor of physics chemistry and botany in the University of Pavia, and the other by RIBONI of the Botanical Gardens of Pavia.

GORINI briefly reviews these two studies (the first of their kind) and gives an account of similar competitions subsequently held by the Society for the Encouragement of Arts and Crafts of Milan (Società di incoraggiamento d'Arte e Mestieri), and the Royal Lombard Institute of Science and Literature. He also mentions other writings dealing with the subject, by PIETRO ALBERTI (1846), CARIO ANTONIO LANDRIANI (1847), GIOVANNI FRANCESCO SELMI, professor of physics, chemistry and mechanics applied to arts, of the *Collegio Nazionale di Torino*, and DAVIDE NAVA, teacher of chemistry in the Milanese Society mentioned above. These writers were followed in more recent times by MUSSO, MENOZZI, PIROTTA, RIBONI, GAETANO CANTONI, SORMANI and GIGLI. It was only in 1878-9, however, that the bacteriology of milk was first dealt with in Italy, the subject being mentioned in four letters written by PIROTTA and RIBONI. In the last twenty years GORINI has himself published books on microbiology in connection with cheese, and Milan has thus kept up a tradition which led to the study of cheese-making from the biochemical standpoint, an example which is now being followed on other countries. (Prof COSTANTINO GORINI "L'Istituto Lombardo, culla di studi caseari". Rendiconto del R. Istituto Lombardo di Scienze e Lettere, series II, Vol. LVIII, No. 1-7. Milan, 1925).

121. **Ths Study of Flora in the Dutch Indies.** — The Bulletin of the Botanical Garden of Buitenzorg, published at Batavia and edited by Drs. W. M. VAN LEEUWEN, F. VON FABER, 1. G. B. BEUMEE (of whom the last named suceeded Dr. J. J. SMITH in the directorship of the Herbarium) contains a scholary study on the Sapotaceae, Sarcospermaceae, and Boerlagellaceae of the Dutch Indies, Malay peninsula and Philippine islands, penned by Dr. H. J. LAM. The writer has availed himself of the large collection possessed by the Herbarium of Buitenzorg, and the two Herbariums of Manila and Sin-

gapore. The subject is handled in an accurate and original manner, its interest being enhanced by many excellent illustrations. (" *Slands Plantentuin*", *Jardin Botanique de Buitenzorg, Bulletin*, Series III, Vol. VII; Nos. 1-2; 289 pp. in-8°, 65 ill. Batavia, 1925).

122. **Rumania: Cotton Growing.** — Following on careful study and practical testing of the best known varieties of Egyptian and Macedonian cotton, and other varieties, the Rumanian Ministry of Agriculture has had the following varieties of cotton seed imported into the country and placed at the disposal of cotton planters: "Sakellaridis", a late maturing variety, suitable for irrigated plantations; it is most in demand on the market, and has the longest, softest, and strongest staple; "Pelion", medium growth suitable for plantations situated in the Danube lowlands; "Ashmuni", a quickly maturing variety, suitable for Oltena and the Banat, and "Balcanica" for Southern Dobrudja and Quadrilaterre. ("' *Viata Agricola*", Year XVI, No. 6, p. 90. Bucarest, March 15th 1925).

123. **Rumania: Introduction of Medicinal Herb cultivation.** — In view of the fact that the climate of Rumania is particularly suitable for the cultivation of most medicinal plants, which already form a considerable portion of the Flora of Rumania, the Department of Agricultural Instruction in the Ministry of Agriculture decided, at the beginning of 1925, that these plants should be introduced into all the Schools of Agriculture. It is intended subsequently to extend the cultivation of these plants with a view to producing a sufficient supply for Rumania's requirements, and in course of time, adding materially to the country's revenue by exporting them. (" *Viata Agricola*", Year XVI, No. 6. Bucarest, March 15th 1925).

124. **The Works of** CELSO ULPIANI. — The complete works of this Italian biologist, which possess so high a value for agriculture, are being collected by Prof. DE DOMINICIS into one volume of about 1500 pages in 16.mo For copies apply to the widow of the late scientist, Signora Emma Ulpiani, San Benedetto del Tronto, Ascoli Piceno, Italia.

Journals and Reviews.

125. The 156th volume (nos. 1-4) of the *Biochemische Zeitschrift* takes the form of a jubilee number to celebrate the 60th birthday of MAX CREMER, professor of physiology in the Veterinary Institute in Berlin. The volume contains about 400 pages, with illustrations, and articles written by eminent German and foreign biologists. Among those who have collaborated are ABDERHALDEN, ROSENFELD, MAGNUS-LEVY, PRINGSHEIM and others.

126. "**Boletín Arrocero**". is the title of the official organ of the Union of Rice Planters, Chamber of Sueca, Valencia, Spain (*Unión Agricultores Arroceros y de la Cámara Arrocera de Sueca*). The first number of this bulletin, which is edited by D. R. FONT DE MORA, appeared in April 1925; and the value of the periodical both from the practical and scientific standpoint, is apparent from the numbers that have so far appeared. Rice problems affecting Spain and other rice-growing countries are discussed in the periodical. — Editor and Publisher: Calle del Maz, 29, pral. (Valencia).

127. " **Wheat Studies** " is the title under which the Food Research Institute of the Standford University, California, is publishing a series of essays dealing with wheat problems throughout the world. The numbers forming the first volume appeared monthly from December 1924 to April 1925. Each article is illustrated by numerous diagrams.

128. The **Revue Agricole de l'Afrique du Nord** has devoted a special number to Co-operative Cereal Stores in Burdeau, Algeria. This co-operative elevator started work on July 21st 1925, and handles grain produced in the Serson region, which is particularly suitable for cereals. The warehouse which is very extensive, is provided with mechanical appliances and may be compared to the American " Elevators " and German " Kornhäuser ". There are two other co-operative elevators in Algeria, one at Brazza (department of Algiers) and one at Maalifs (department of Orano). Both of these are smaller and are not provided with machinery. (BOYER-BANSE and FURGIER. Le dock coopératif à céréales de Burdeau. *Revue Agricole de l'Afrique du Nord*, Year 23, No. 301. Algiers 1925).

129. **France: A new Bulletin for Togo and Cameroon.** — In accordance with instructions given by the two French Commissioners in Togo and Cameroon, the Economic Agency of the African territories held by mandate (*Agence Économique des Territoires Africains sous mandat*) now issues a monthly bulletin, the first number of which appeared in April 1924 containing information of an agricultural and economic nature, statistics, shipping news, applications for and offers of posts, and extracts from the principal publications dealing with the region (*Bulletin mensuel d'informations*, 37 Rue Taitbout, Paris).

130. **Special Huxley Number of " Nature "** : — " *Nature* " has published a special Huxley Centenary Number (May 4th 1825-May 4th 1925) to commemorate the centenary of the birth of THOMAS HENRY HUXLEY. The special number contains numerous biographical accounts of the great scientist as well as articles dealing with the far-reaching influence of his work on various branches of science. (*Nature*, Vol. 115, No. 2897. London 1925).

131. **The Indian Forester** has celebrated its 50th birthday (1875-1925), No. 7, Vol. LI, of the periodical is issued in the form of an artistically illustrated jubilee number and contains a number of interesting retrospects relating to the history of forest cultivation in those regions. (*The Indian Forester, Jubilee Number* 1875-1925, Vol. LI, No. 7).

132. " **Italia Agricola** ", the organ of the Italian Federation of Agrarian Consortia, which has its headquarters in Piacenza (Italy) devotes a special number to wheat problems, partitularly those affecting Italy. It contains articles by eminent personalities in the agricultural world: C. DRAGONI : A Brief Survey of Wheat Production and Trade throughout the world ; E. MORANDI : Italy's Wheat Supply ; A. SERPIERI : Wheat growing in Italy viewed from the economic standpoint : V. ALPE : Progress of scientific methods in their application to the wheat trade ; E. AZIMONTI : Wheat Growing in the South ; A. MAROZZI ; Corn, and land reclamation ; F. TODARO : Improved varieties and increased production ; A. DRAGHETTI : Earliness in new wheats ; E. BASSI : Production and trade in selected seeds of crop plants in Italy.

133. " **La Terra** " the Italian review which deals with the problem of national reconstruction devotes its eighth number (August 1925) to the difficult

problem of land reclamation in Southern Italy. Interesting articles appear on reclamation in the table land of Apulia, in Sardinia, the Ionic Province, and Calabria, on irrigation in the dry districts of Southern Italy, and on the legislation connected with land reclamation. (*La Terra*, Year 1, No. 8, Bologna, 1925).

134. **World Agriculture,** the organ of the " World Agriculture Society ", U. S. A., has published a special *Czechoslovakia* Number (Vol. IV, No. 3, 1924, 137-9, East 25th Street, New York). The number contains illustrated articles on the various aspects of agriculture, forestry, animal industry, etc., in Czechoslovakia by Dr. V. BRDLÍK, Dr. F. TUMLIŽ, Dr. Marie KUKLOVA, Dr. A. MATAUŠEK, Dr. V. SEVČÍK, Dr. J. SOUČEK.

Personal.

135. GUSTAVE ANDRÉ, professor of the *Institut National Agronomique* of Paris has been elected a member of the *Académie des Sciences*, where he will occupy the seat left vacant by prof. MAQUENNE. ANDRÉ was a pupil and collatorator of BERTHELOT, with whom he first undertook research work in connection with agricultural chemistry, devoting particular attention to the nitrogen cycle and phosphorus in vegetation and ascertaining the action of magnesium in the functioning of chlorophyl. At the IV International Soil Science Conference held in Rome in May 1925, ANDRÉ gave a successful lecture on " Nitrification and its consequences in agriculture ".

136. The science of Agronomics has lost an eminent invéstigator in ÉMILE CARPIAUX, director of the Station of Chemistry and Agrarian Physics at Combleux. He collaborated with prof. E. LAURENT in the considerable research work undertaken by the latter in the Botanical Laboratory of the well known Agricultural Institute there. He was greatly interested in questions concerning the feeding of livestock and the action of biogenic mineral substances. Among his many writings, he is responsible for a study on aviculture, the four editions of which testify to the well merited recognition it met with.

137. The death is announced of ADRIEN HALLET, one of the most active and cultured personalities in Belgian colonial circles. An indefatigable worker in the Congo, where he was placed at the head of important colonial companies, and in Malaya where he formed extensive plantations of *Hevea* and *Elaeis*, he had decided to return to the Belgian Congo, there to make use of the valuable experience he had acquired in the Far East, when, after obtaining large grants of land for the *Société des Palmoraies Congolaises* with a view to oil palm growing, his plans were cut short by death.

138. The death has occurred of Senateur PIERRE FOQUET, member of the Superior Forestry Council of Belgium. Senateur FOQUET was the owner of large areas of forest land which he supervised with exceptionally thorough knowledge. 45 years ago he began the progressive afforestation, of the forest of Luchy, which contained large numbers of unproductive cedar trees. Though not a pioneer in this work, he was one of the first to undertake it on a large scale.

139. Dr. WILLIAM T. HORNADAY of the New York Zoological Society has been awarded a gold medal by the International Congress for the Study and Protection of Birds.

140. The High School of Agriculture (*Landwirtschaftliche Hochschule*) of Hohenheim (Germany) has lost one of its most distinguished professors in Dr. OSCAR KIRCHNER, who occupied the Chair of Botany, and whose death occurred on April 25th 1925.

141. The death is reported of Professor H. MAXWELL LEFROY, on October 14, at the age of 48. He was Professor of Entomology at the Imperial College of Science and Technology, London, and had already made a great reputation as an economic entomologist. In 1899 he was appointed entomologist to the Imperial Department of Agriculture for the West Indies, and subsequently became Imperial Entomologist for India. Prof. LEFROY published many official papers, and three important books. "Indian Insect Pests" (1906); "Indian Insect Life" (1910); and "A Manual of Entomology" (1923). The silk and cotton industries owe much to him and his advise on the destruction of insect enemies of tropical agriculture has been of great service. His death is attributed to his ardour in research, as he was overcome by gas fumes while experimenting in his laboratory at the Imperial College (*The Times*, London, October, 1925).

142. Prof. BARTOLOMEO MORESCHI, Lecturer on Zootechnics in the University of Rome, and Director General of Agriculture in the Ministry of Agriculture, from 1909 to 1918, has recently died in Rome, at the age of 70.

143. HENRI SAGNIER, permanent secretary of the French Academy of Agriculture has received a noble tribute from the Académy on the occasion of his 88th birth-day. Editor of the *Journal d'Agriculture pratique*, a former collaborator of BARRAL, editor of the *Journal d'Agriculture*, a familiar figure to all those interested in the French agriculture at the present day, SAGNIER may be considered to be a veteran of the agricultural press of the last half century.

144. The death has been announced of Prof. GUNNAR SCHOTTE, Director of the Experimental Forestry Institute of Sweden.

Prof. SCHOTTE, to whose organising ability the Swedish Experimental Institute owes much of its importance, was also well known as a dendrologist, being the author of studies on the origin of forest seeds. In accordance with the wishes of the International Union of Experimental Forestry Stations, Prof. SCHOTTE carried out experiments in connection with the cultivation of forest seeds, especially as regards the Baltic Pine. Prof. SCHOTTE, died on August 28th last, at the age of 51.

145. The death has occurred, in a small village of the Woevre, at Woel (Meuse), of LEON STEF, the Honorary Forest Keeper, at the age of 68, after a long career as official of the Administration of French Forests. Most of his life was spent in the district of Verdun, among the thick woods which cover the slopes of the Côtes and the plain of the Woevre, on the right bank of the Meuse.

146. The death is announced, at the age of 60, of Dr. JULIUS WORTMANN, professor and former director of the Didactic and Experimental Institute of Viticulture, and fruit and vegetable cultivation of Geisenheim (*Lehr- und Forschungsanstalt fur Wein- Ost- und Gartenbau*).

Prof. WORTMANN first occupied the post of lecturer at the University of Strasbourg, and was joint editor of the Botanical Journal (*Botanische Zei-*

tung). In 1871 he succeeded Prof. MÜLLER-THURGAU in the directorship of the Experimental Station for Plant Physiology (*Pflanzenphysiologische Versuchs-Station*), connected with the Royal Enological and Horticultural Institute (*Königliche Lehranstalt für Wein- und Gartenbau*). He published the outcome of his researches in valuable studies on fermentation and plant diseases. In 1894 he founded the first German yeast producing station, which was followed by the introduction of courses on fermentation. In 1903 he succeeded Prof. RUDOLPH GOETHE in the directorship of the Geisenheim Institute mentioned above, which he reorganised and developed. He was president and member of various important viticultural associations, and in 1907 refused the post of Director of the Imperial Institut of agrarian Forest Biology of Berlin-Dahlem.

Dott. G. A .R. BORGHESANI, *direttore responsabile*.

ORIGINAL ARTICLES

A PHYTOTECHNICAL STUDY OF A USEFUL WILD BRAZILIAN PLANT.

On the farm land surrounding S. Bento das Lages and Brotas, where the Bahia Agricultural School is situated, a wild plant may be found, growing alike freely on clay and sandy clay soils, as well as on the sandy and stiff soils, called in Brazil " massapé ". The plant is known locally among the peasants and shepherds by the name of " gravitaia ".

It is a member of the family *Amaryllideae,* but is not, though in many respects closely resembling it, the *Carlotea,* or *Carapitaia,* sometimes called of Arruda, which is an Amaryllis proper, but a member of another genus of the same family, viz. the genus *Hypoxis,* the species being known as *Tuber brasiliensis.*

The plants belonging to the family of the *Amaryllideae* have textile, medicinal or poisonous properties, and are often very ornamental. The species here described, besides being ornamental, provides excellent forage for cattle, and also a considerable quantity of edible, sacchariferous tubers. Although some species of *Amaryllideae* may be found in the temperate zones, they are properly speaking tropical plants, and the " gravitaia " which forms the subject of this study is found in the northern parts of Brazil and Bahia where the average temperature is about 24° C.

It is an annual, and non-resistant to drought, but on the other hand resists the cold season and the frosts of July and August. As during the torrid summer heats it only thrives in the shade, it may be regarded as a shade plant.

The best season for sowing is the autumn. The plant was grown by the writer in 1901, 1913, and 1914, and specimens obtained meas-

ured 1.6 m., 2 m., 2.20 m., 3.30 m., 4.84 m., and had from 32 to 36 leaves, 13 centimetres long and 0.034 m. in width.

Owing to the beauty of its flowers, the plant may be grown for ornamental purposes. The outer perianth is rose-coloured, paler on the inner side: the inner perianth is light green with red spots and dashes, the principal vein being of a red velvet colour.

The plant may also be cultivated for its starchy, sacchariferous, edible tubers, of which an analysis will be given later ; these as well as the leaves make useful stock feed.

Oxen and horses eat this plant readily and it is apt to be grazed down as soon as found.

With a view to making a complete study of the development of this plant including flowering and fructification and for classification purposes, the writer in April 1902 transplanted a single specimen, found in a wild state, placing it in sandy clay soil with some humus, previously prepared. In the month of August on this single stem thus transplanted there were six well developed shoots and a bud or new shoot. One of the six shoots showed a single flower, while on a bifid shoot there were two peduncles each with two flowers, and on a trifid shoot two, each with three flowers.

The tubers were larger than those produced by the plant in the wild state, when in rare cases only they exceed 0.035 m. in length, and 0.025 in width, and attain measurements of 0.047 by 0.034 as shown in fig. 8. The tubers are slightly hairy externally, the leathery xanthophyllous epidermis is covered with a downy, velvety layer or surface of a straw colour.

Classification of the " Gravitaia ".

The flower.

The flower (figures 24 and 25) has a double perianth and the stamens and pistil are in the same flower and ripen simultaneously.

The male organs (androecium) consist of six hypogynous stamens with subulate filaments, i. e. thicker at the base than at the apex, as shown in figures 26 and 27 at *a*, *b*, and *g*, where they are represented at three stages of development. Up to the fourth day they differ in size, two being shorter or smaller and four larger or more developed, in other words tetradynamous, as shown in figure 27 at *a*, *b*, and *g*.

From the first to the second day the anthers which are ovoid

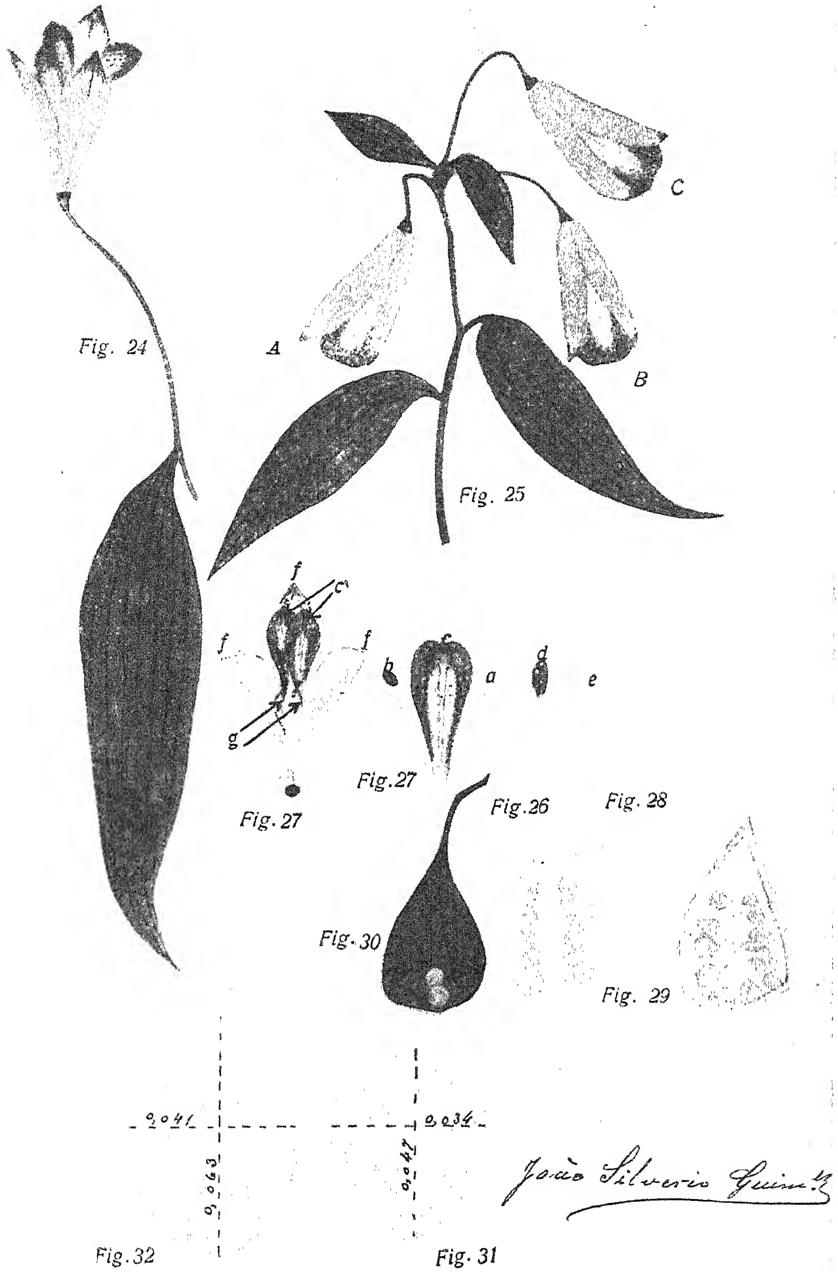


Fig. 24 - Flower of the « Gravitaia » at the top of its branch, and leaf — Fig. 25 - Terminal trifid branch with flower — Fig. 26 - Stamen in mature state with a dark green anther — Fig. 27 - Tepals or perianth leaves, showing inner side and stamens, with atrophied anther — Fig. 28 - Pistils during fertilisation,

in form, become dark green instead of yellow, reddish or red. The gynaeceum, pistil or carpel, consists of the inferior ovary, the tubular cylindrical style, and the trifid or tri-lobed stigma, shown in the figure at *e*.

When the pollen is ripe the larger stamens bend over and approach the ovary for fertilisation.

According to the Linnean classification the flower is hexandrous and trigynous

Figure 24 shows a flower at the apex of a shoot and a leaf.

Figure 25 represents a terminal trifid branch shoot with a flower on each peduncle and four leaves. The flowers, A, B, and C, in figure 2 show respectively the outer floral leaves which are rose-coloured, and the inner ones seen from the front, which are of a yellowish colour, with dark red spots. The third apical flower shows at C the inner perianth or floral leaf seen from the back of a dark green colour spotted like the others. Figure 27 shows at C, C', and F the perianth leaves seen as it were from within or from the outer edge; at *a* and *b* are seen stamens with atrophied anthers. Figure 28 shows the pistil at the time of fertilisation, with the tri-lobed stigma and its sharply pointed lobes as seen at *e*. When these lobes are pollinated, the edges close over.

Figure 26 represents the stamen at time of fertilisation and at *d*, its dark green anther.

The Fruit.

The fruit is an inferior dehiscent capsule, with six divisions or loculi, each containing five or six seeds, orange coloured tending to red, of the shape and size of a pomegranate seed.

Figure 29 shows the fruit cut in section and the arrangement of the seeds, and figure 30 the whole fruit showing dehiscence at point *h*, where the orange coloured seeds are shown. When these ripe seeds fall on the ground they germinate and are the means of reproduction, as well as the tubers which remaining in the soil send up fresh shoots, as soon as the temperature becomes favourable to growth.

Tubers of the "Gravitaia".

Figures 31 and 32 represent the tubers at their natural size, the argest that have been obtained by the writer by cultivation. The

epidermis of the tuber is very tough and leathery or coriaceous, and when the plant is flowering or at flowering time it is of a saffron yellow in colour.

This colouring matter which is insoluble in water or alcohol, is soluble in ethyl ether, and on analysis has been classified as phylloxanthin, both on account of its colour, and from its properties which are identical with those of that substance.

Prior to the formation of this colouring matter in the inner mass of the tuber, a substance of a pale red colour appears similar to erytrophyll or carotin. In the wild state the tubers are from 0.047 to 0.050 m. long and from 0.034 to 0.035 in width (fig. 31) and one plant bears 11 to 15 tubers. On cultivation the writer obtained 23 to 30 tubers measuring 0.063 by 0.041 m. (fig. 32).

The tubers are attached to the extremities of the roots which are fibrous and rigid, about 0.3 long, and resemble the creeping rootstock of the fern, known as " samambaia." A proportion or geometrical ratio or progression exists between the number of tubers produced by a plant and the number of flowers on a shoot.

On a plant bearing five flowers eleven tubers were found; on one with twelve flowers, twenty-three tubers ; on another plant fourteen flowers on one spray and thirty-two tubers. A common ratio is to be observed between these three sets of numbers : 5, 11 ; 12, 23 ; 14, 30.

The main stem is much branched, climbing but without tendrils, the leaves are alternate and lanceolate (figs. 24 and 25), of a glossy dark green on the upper side and ash-coloured underneath. On each spray there are from 32 to 36 leaves of 13 centimetres in length and 34 millimetres in width (0.13 by 0.034 m.) the leaf stalk being twisted.

It belongs to the class of the *Liricidae* of Brogniart, to the family of the *Amaryllideae*, to the genus *Hypoxis*, tribe *Hypoxideae* ; the name given to the species is *Tuber brasiliensis*, from the country where it is indigenous.

Chemical Composition of Tuber Brasiliensis.

Analysis of the tubers grown in 1901 (1).

Substance of the epidermis	Phylloxanthin
Starch	Asparagin

(1) Plant grown and analysed by the writer in 1901. The results are published in the *Boletim de Agricultura da Bahia*, IV, Vol. 3, March and April 1904, Nos. 3 and 4.

Carbohydrates . .	Polysaccharides	Cellulose Starch
	Monosaccharides	Glucose
		Water
Organic Acids. . .	Oxalic Tartaric Malic Citric Formic (alkaline formate)	
Ash.		

The green leaves have very nearly the same chemical composition as the tubers, containing chlorophyll, instead of xanthophyll, nitrogen, water, starch, glucose, potash, acids, etc.

The analysis of the leaves was effected at the same time as that of the stem.

Cultivation of *Tuber brasiliensis* in the Farm Training School of Bahia.

In Brotas.

The experimental cultivation was undertaken a second time in 1913 with a different object.

After the classification and analysis of the plant had been completed, it was decided to make a comparative and analytic study of the quantity of the acids and of the carbohydrates. Different plants were placed in beds of soil in the full light and exposed to the action of the solar heat, and on the other hand in pots, in the shade, in a diffused light and at a lower temperature. Each plant had a space about 0.44 m. wide, and the same depth of soil. The sowing took place in April, i. e. the autumn season in Brazil, and the most favourable for their natural development, and on August 19 they were in flower, as they would be in the wild state.

Condition of the Plants on 19 August 1913.

Bed	No.	1	plants of	five	stalks	of	2.20 m.	each
»	»	2	»	six	»	»	2.20 m.	»
»	»	3	»	three	»	»	3.30 m.	»
»	»	4	»	three	»	»	4.84 m.	»

The plants in beds Nos. 1 and 2 showed, some five and others six flowers and produced 11 and 15 tubers.

The plants in bed No. 3 had some stalks with 12 flowers and produced 23 tubers.

The plants in bed No. 4 showed some stalks with 14 flowers and produced 30 tubers.

The tubers examined contained the same predominant acids: oxalic and tartaric; starch and glucose, occurring in the same parts of the plant in which starch occurs, also dextrose, in a proportion of 4.44 per cent. The deviation of this latter to the right of the plane of polarisation is about 50 degrees, that is to say it has a right-handed polarisation.

The dextrose may appear on heating by hydrolysis of the starch which breaks up under the action of the acids. In such conditions saccharose cannot be formed, since apart from the invertase (or sucrase), a dissolving diastase, the invertin of the saccharose, the simple presence of an acid is sufficient to set up the inversion of this carbohydrate disaccharide and in so far as the acidity persists it would be impossible to obtain any quantity of this crystallisable sugar or saccharose.

The starch produced by chlorophyll assimilation produces under the action of acids disaccharide maltose which is isomeric with saccharose; and maltose formed under the action of the same acids is transformed into monosaccharide or dextrose. This appears to be the physiological and bio-dynamic action of these organic compounds. In the higher plants the vegetable acids appear as intermediate between the carbohydrates and carbon dioxide gas, and form the products of incomplete oxidation or respiration.

Radiation plays an important part in removing acidity, and an increase in temperature even more so. If the acidified plant is exposed to the sun's rays, the acids gradually disappear.

The direct and intense action of light brings about complete oxidation of the acids, and stimulates the action of chlorophyll, thereby taking a very important part in the removal of acidity. The vegetable acids are products of oxidation or of incomplete respiration, tending to form bodies which are less oxygenated than carbonic acid, which is the final result of the combustion of carbon, and more oxygenated than carbohydrates, the typical form of which is, in the case under consideration, glucose. At a low temperature there is solidification; at a high temperature the acids are destroyed. The

raising of temperature increases or accelerates respiration, and when this becomes more active, assimilation increases with the growth of the plant and with the formation of new leaves, the formation of reserve material being more rapid whenever synthesis increases. When the oxidation of the glucose is diminished owing to greater respiratory activity, there is an increased production of this carbohydrate, as the quantity of acids is reduced; if the formation of the acids and of the glucose is physiologically modified, as I conjecture to be the case, by the action of the physical agents, light and colour, it is possible that the reserves of this monosaccharide become concentrated in saccharose or at least that this disaccharide product does not completely break up into dextrose and levulose, in proportion as it goes on forming in the way it probably does. Glucose seems to give rise by concentration or oxidation to acids in the following order: citric, malic, oxalic, formic acid generally appearing in combination. This series of acids is a kind of scale of concentration, of intermediate oxidations between the extremes of the carbohydrates and carbonic acid gas, and in my opinion it is to be attributed to incomplete respiration. It may well happen that from this cause one or other acid is not present at any given moment in the cycle of growth. To ascertain this, the writer grew the plant in the shade and in the full light of the sun, with the object of comparing the results of the respiration activity; in other words, I attempted to diminish the acidity if not to make it disappear entirely, and thus obtained a certain reserve or production of saccharose. This shows that G. ANDRÉ was quite right when he says in his " Chimie végétale " (1):

" When plants have a cell sap which is prevailingly acid, they contain little saccharose: it would seem that the condensation of the reducing sugar is counterbalanced by the inverse hydrolysing action which the acids exercise on saccharose ".

Dextrose seems to be the result of the decomposition of the acid or of the saccharose.

When the green leaf is examined during the day, dextrose is not found: if picked and kept in the dark, dextrose appears. Starch on the contrary is present during the day and according to experiments of the writer it is more abundant in the evening up to 11 p. m. than from midnight to 8 a. m.

(1) *Chimie végétale*, p. 143.

Analysis of the Carbohydrates contained in the leaves of Tuber brasiliensis *as grown in Brotas.*

2 October 1913. Cultivation in the shade	2 October 1913. Cultivation with complete exposure to the sun
Analysis No. 1. Leaf analysed at 5.30 p. m. Contained starch No dextrose.	Analysis No. 1. Leaf analysed at 5.30 p. m. Small trace of starch at edges of leaf No dextrose.
3 October 1913. Cultivation in the shade.	3 October 1913. Cultivation with complete exposure to sun.
Analysis No. 2. Leaf examined at 8 a. m. Complete absence of starch Contained dextrose.	Analysis No. 2. Leaf examined at 8 a. m. Small trace of starch in less proportion than in the evening Contained dextrose.
3 October 1913. Cultivation in the shade.	3 October 1913. Cultivation in the sun.
Analysis No. 3. Leaf examined at 11 p. m. Slower decomposition of the chlorophyll Contained sufficient starch » » dextrose.	Analysis No. 3. Leaf examined at 11 p. m. More rapid decomposition of chlorophyll Contained a larger quantity of starch than the leaf of the plant grown in the shade. Contained dextrose.

To prevent any challenge of my analysis, I sent to the Professor of Analytical Chemistry at the Bahia Agricultural School, Dr. Paul Huart Chevalier, a number of tubers grown by myself in Brotas, so that he might make a fresh comparative analysis of the components, as a check on mine. I append the result of the analysis to which he subjected these tubers which in every way confirms the analysis I made in 1901 and again in 1913.

To the letter I wrote on 13 October 1913 Dr. Chevalier replied as follows :

« I enclose the results of the very brief tests I have been able to make of the material you sent :

Reaction with Fehling's liquid	abundant
» » sunflower (sap reaction) . . .	acid
Polarisation	righthanded
Glucose in 90 cubic centimetres of sap . . .	4 grammes

It is the glucose which is the sugar of the sap that imparts the sweet taste.

Acid. The acidity is due to malic acid, and I have succeeded in recognising malic and tartaric acid.

Starch. We have extracted the starch from the tubers and have obtained a very white starch ; examined under the microscope it shows very fine granules of the same size as those of potato starch and of nearly similar form. It presents the characteristic hylum. In short, cells of this shape are found, figure 33 showing the granule formed by concentric layers ".

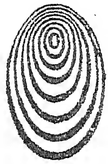


FIG. 33 — Section of the grain of starch of *Tuber brasiliensis*.

As has already been said, in addition to its qualities as a forage plant, the plant is highly ornamental. As a tuberous plant it serves as a chemical and mechanical corrective of the soil, and among other uses the juice of the tubers can be employed for the manufacture of alcohol, and the starch can be extracted and utilised for all kinds of industrial purposes.

The soil best suited for its cultivation is a sandy-clay soil with humus, but it also thrives on sandy soils, sandy-clay and on the clay known as " massapé ".

DISEASES AND PESTS OF THE *Tuber brasiliensis*.

From the observations I have been able to make on the wild types and on plants cultivated by myself, they appear to be resistant to the usual diseases of exotic plants, as with the exception of the round spots of a brownish colour which I have observed to appear on some leaves of a few plants after flowering and which resemble rust stains, I have not discovered any pathological symptoms.

The species is without the numerous pests such as infest lucern and other forage plants.

Crickets nibble the young plants down to the ground. Shoots are frequently bitten off by these orthoptera to the height of a decimetre.

The arachnids being insectivorous are not strictly speaking plant pests, but their larvae, though not vegetable parasites, are from time to time found on the underside of the leaves, where holes of irregular shape are formed. Small red spiders about 0.002 m. long often spin their webs over the plant and spoil it. There is also another spider

of about 0.006 m. long, with a greenish coloured body with pink stripes and a straw coloured head spotted black. This arthropod is harmless as it belongs to the order of the muscivors, and it undoubtedly acts as a sort of guardian of the plant, protecting it against the attacks of the diptera which feed on it.

The " sauvas ", the mandioca ants, also bite the leaves of the *Tuber brasiliensis* and are the most troublesome of the pests encountered in its cultivation.

João Silverio Guimarães,
Agricultural Engineer, Bahia, Brazil.

THE REJUVENATION OF THE ANIMAL ORGANISM.

Introduction.

The conception of the possibility of rejuvenating senile animals is not new. The rejuvenating effects of suitably graduated physical exercises have been recorded by Rouhet, Desbonnet, F. Heckel, and others; on the recovery of development in animals subjected to long fasting and then fed intensely, see Morgulis, Goetsch, etc.; on the regeneration of parts lost in lower animals, Schultz, and especially on the renewal by grafting in higher plants, whose lives can be prolonged considerably. But to Brown-Séquard belongs the merit of having pointed out a new way of rejuvenation of the animal organism, by his communication made to the Biological Society of Paris in June 1889, in which were described the effects of true rejuvenation, proved by him at the late age of 72 years, by means of subcutaneous injections of the extract obtained from fresh testicles of guinea-pigs and dogs.

Identical but more lasting effects were subsequently obtained by Steinach, Voronoff and other experimentors, by the tying of the duct of the *vas deferens* and by transplantation of testicles and ovaries of young animals.

The results hitherto obtained have given rise to numerous problems which touch the very essence of biology and the moral and social conception of human life. These should be discussed in relation to their theoretical foundation before being accepted by our imagination, which is too much accustomed to consider as inexorable the vicissitudes of life and death, of youth and age.

Modern views regarding advancing age.

Old age and death have at all times appeared implicit in the very conception of life. Common observation shows indeed that every living species, whether animal or plant, among specific hereditary characters, has that of the duration of life.

But the death of each organism, as it ordinarily happens, can always be connected with external causes which at some time have acted on it. *Natural death*, understood as the expression of the uniform senile atrophy of all the structures of the organism, which leads to the depression and finally to the simultaneous extinction of all functions, probably never occurs, unless (ROBERTSON) the organism is placed in absolutely ideal conditions so as to be safeguarded from all external causes of disease.

The conception of the existence of immortal forms of life among unicellular organisms which reproduce themselves by direct division, now shared by biologists, is due to WEISMANN. According to this writer there is a very essential difference between multicellular and unicellular organisms; the former are destined to die, the latter, on the other hand, are immortal in the sense that if a unicellular organism does not die from external causes, on attaining a certain size it divides by splitting into two parts, each of which develops and subsequently divides and so on to infinity, without the occurrence of any death.

The immortality of unicellular organisms, in WEISMANN's conception, would be due to the fact that all the organic functions, including reproduction, are collected in a single cell which includes the *mortal soma* and the immortal *germ plasm*. Arrived at the limit of their evolutionary capacity these cells do not perish, nor are they destroyed, but split into new elements.

In multicellular organisms death would be due, on the other hand, to the incapacity of the somatic cells to reproduce themselves indefinitely, owing to which in the course of their evolution they exhaust themselves while the germ plasm, transmitted from generation to generation by means of the gametes, is potentially immortal and unites one transient generation to another.

Objections have been raised to the doctrine of the immortality of unicellular organisms. HERTWIG observed that when a unicellular organism splits into two, even if there is no actual dead body, practically there is the disappearance of an individual existence, which is perpetuated in the descendants, by means of a mechanism profoundly different from that of a multicellular being, but with the same significance. MAUPAS found that the unlimited propagation of unicellular animals by division is not possible without the occasional stimulus of conjunction. He observed that *Infusoria*, after a long series of splitting, suffer a true senile atrophy and perish

unless conjugation takes place. This intermixing rejuvenates the culture and makes it again capable of reproduction by division for many consecutive generations.

The periods of reduced reproductive capacity, observed by MAUPAS and by other wr ters in the *Infusoria* cultures, were however attributed by LORAND, LOSS, WOODRUFF to the unchanged composition of the medium — *monotony of environment* — and to the gradual exhaustion of the nutritive materials necessary for the nuclear and cytoplasmatic synthesis. Transferred to a new medium the unicellular organisms achieve a real "rejuvenation" because the greater nutritive power of the medium allows the nuclear synthesis which is necessary for division. ROBERTSON has however observed that individuals, isolated from an old, densely populated culture, often show a prolonged lag-period during which their capacity to multiply appears to be so depressed as to render new transplants difficult. In this way irregular rhythms of reproductive capacity may be established in the descendants of a culture, which are really attributable to variations in the conditions of the culture medium at the very moment when the new individuals are isolated for transplantation.

Thus, with a constant renewal of the nutritive medium, there is no doubt that among unicellular organisms multiplication by division — except in cases such as that investigated by CALKINS for *Uroleptus mobilis*, — can be continued theoretically to infinity. As a matter of fact, WOODRUFF with frequent renewal and variation of the nutritive medium, obtained 8400 generations of *Paramoecium aurelia* in thirteen years, without any loss of reproductive capacity and without conjugation taking place at all.

MÉTALNIKOV experimenting for 10 years on *Paramoecium caudatum* obtained similar results.

The aptitude however, for unlimited multiplication by division is not restricted to unicellular organisms. The somatic cells also, belonging to differentiated tissues, are virtually capable of infinite multiplication. Recent investigations on the culture of tissues *in vitro* have indeed shown that, in suitable experimental conditions, the increase of some differentiated tissues can be indefinitely maintained. CARREL and EBELING for over twelve years cultivated connective tissue *in vitro*, which after 2500 transfers preserved intact proliferative activity and constantly doubled its mass every 48 hours. Epithelial tissue proliferates *in vitro* constantly

every 18 months, and even the thyroid has been cultivated *in vitro* without the cell losing its morphological aspect and its specific chemical activity. JENSEN's tumours have been propagated by transplantation through many generations and have greatly exceeded the duration of life of the host.

As a whole these facts show that, contrary to the fundamental hypothesis of WEISMANN, unlimited reproductive capacity is not only an attribute of unicellular organisms and of germ plasm, but also of somatic tissues. From a strictly theoretical view point, it may indeed be asserted (ROBERTSON) that not only is death not the necessary result of life, but that potential immortality, with unlimited capacity of reproduction, is a universal characteristic of matter.

Senile atrophy, which animal tissues undergo, consists of a series of structural deteriorations and relative feebleness of all the functions of the organism. SALIMBENI and GERY made a study of the tissues of a woman 93 years of age, who died in consequence of acute disease of scarcely 36 hours duration, on which account can be excluded the confusion with special lesions due to disease of long standing. They found widely diffused sclerosis in almost all organs, infiltration of leucocytes, thickening of the glandular tissues, fairly frequent calcification of the arteries, of the choroid plexus and of the spinal medulla ; signs of enfeebled action of the thyroid and of the epiphyses and enfeebled action of the suprarenal bodies, as well as lesions, which were however considered as of slight importance in view of the age of the woman.

Sclerosis, which has a dominating influence in the structural deteriorations of advanced age, has been reduced by METCHNIKOFF to a single type, sometimes affecting the walls of the arteries and sometimes the parenchymatous tissues, or the osseous tissue, or the nervous tissue. In any case there is infiltration of phagocytes, which are mononuclear leucocytes, or fixed endothelial connective, nervous or muscular cells, which absorb the worn out anatomical elements and take the place of these, being transformed into connective tissue.

Senile atrophy might be indeed characterised, in all organs, by gradual substitution of differentiated tissues by hypertrophic connective tissue.

In bones in process of senile degeneration, the tissue of the osseous lamellae is gradually replaced by giant osteoclasts, whence

the *osteoporosis* and spontaneous fracture so frequent in old persons. In the nervous centres it is the cells of the neuroglia which replace the nervous cells, whence progressive weakening of the intellectual faculty and of the coordinating action of the brain on the other organs. In the muscles it is hypertrophy of the muscular cells which reduces the contractile substance of the muscular fibres, whence the muscular weakness of old persons. In the arteries it is the inner coat which is the seat of deterioration: the lesion extends subsequently to the other coats of the walls of the arteries causing endoarteritis, the immediate effect of which consists in decrease of elasticity of the walls and narrowing of the lumen of the artery.

In the course of this investigations METCHNIKOFF was struck by the identity presented by the lesions proper to senile degeneration and by certain lesions due to pathogenic bacilli. Arteriosclerosis especially may occur as a consequence of many infective diseases, *syphilis*, *typhus*, *malaria*, *diptheria*, etc., but also sclerosis of other organs is not infrequent among the after-effects of infective diseases, especially of syphilis, and between a senile kidney and a kidney with interstitial nephritis (BESREDKA) there is, from the point of view of their structure, more than a simple resemblance. Sclerosis in these cases would be produced by *bacterial poisons* which preferably attack the specific cells of the tissues, while the *phagocytes*, more resistent to the action of the poisons, end in absorbing the affected cells and take their place, transforming themselves into connective tissue.

On the basis of the identity of the lesions produced by bacterial poisons and those found in senile atrophy, METCHNIKOFF attributed the latter to processes of a microbic nature and in contrast to the usual conception of the physiological origin of old age, considered advancing age as a disease of late evolution. The origin of the poisons which cause senile sclerosis have been attributed by METCHNIKOFF to the large mass of germs which are renewed daily in the large intestine of mammals.

While circulating in order to be eliminated by the kidneys, the toxic products of intestinal fermentations cause a slow poisoning, the external symptoms of which are precisely those of advancing age. METCHNIKOFF endeavoured to attenuate the toxic effects of the intestinal fermentations by suggesting the ingestion of *lactic bacteria* which, in his view, are strongly antagonistic to other microbic spe-

cies of the intestine, and are less injurious. Recent researches (KOESSLER) have however demonstrated that the flora of the intestine is not substantially modified by the ingestion of cultures of lactic bacteria, nor are the substances thus produced in intestinal fermentation entirely deprived of toxicity.

The analogy established by METCHNIKOFF between the effects of poisons on tissues and senile degeneration may be considered to be correct and the lesions produced by the microbic toxins constitute without doubt an acceleration of advancing age. However, the inmost mechanism of advancing age is not made clear by this ingenious theory of METCHNIKOFF.

MÜHLMANN, referring to the work of ROUX and of LEWES on the struggle for existence between the anatomical elements of the various tissues of multicellular organisms, considered that one of the mechanisms, perhaps the most important, by which the specific cells came to be substituted by connective cells, consists precisely in deficient nutrition due to progressive development of less differentiated tissues. Indeed in a nutritive medium inhabited by cells of higher Metazoa, the latter cease to multiply and to produce new cells when the material becomes insufficient for nuclear synthesis, which is the principal characteristic of growth. The smaller size of the nucleus of the anatomic elements of certain tissues of purely structural importance, renders however their multiplication possible even in nutritive media no longer suitable for the nuclear synthesis of cells with highly developed nucleï, such as nervous cells. The progressive replacement of these cells by others less differentiated then takes place, until the weakness of their function causes the death of the whole association. Thus in the struggle for life the less differentiated cells have an immense superiority over the more highly differentiated cells.

According to T. BRAILSFORD ROBERTSON it is not real deficiency of nutriment which decides the fate of the differentiated cells, but the simultaneous increase in auto-catalytic power, which makes nuclear synthesis impossible for them.

He attributes the progress of the complex process of nuclear synthesis to the progress of an *autocatalytic monomolecular reaction* and to represent its mechanism considers the case of a community of physiologically similar cells — as for instance a culture of Infusoria — in medium the nutritive level of which is maintained constant by introduction of new material at regular intervals.

Nuclear synthesis in each cell of the culture thus tends towards the equilibrium expressed by the formula :—

$$X_{ex} + X_{end} = \frac{K_1}{K_2} a$$

in which X_{ex} represents the autocatalytic power possessed by the nucleus of each cell at the moment of the preceding division, and X_{end} represents that which is subsequently attained in the daughter cells. Suppose that a cell of the community acquires the capacity of dividing its nuclear substance, before equilibrium is reached, when, that is to say, the other cells of the community are still unable to divide, the process of nuclear synthesis becomes more rapid in the new type of cell, because the smaller volume of the nucleus required for division is repeatedly formed. We have thus an energetic nuclear synthesis of an association in which at first it took place much more slowly.

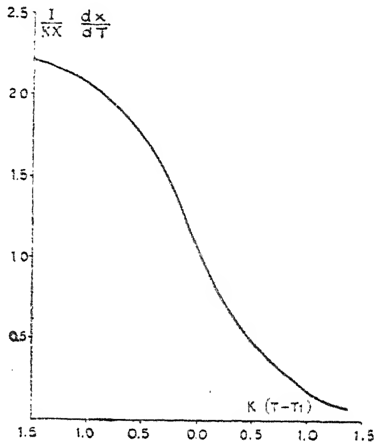


FIG. 34. — Relation between the rapidity and the intensity of transformation at different stages of an autocatalytic mono-molecular reaction.

But the nutritive level assumed as constant, being already scarcely sufficient to maintain equilibrium of nuclear synthesis in the old type of cell cannot, when used to determine a more rapid synthesis in other cells, preserve the equilibrium originally required by the nuclear synthesis of the old type of cell. We have, that is to say, a decrease in the nutritive level for the old type of cell, and a new equilibrium of nuclear synthesis is established which approaches to that which will finally be attained by the new type of cell. The old type of cell consequently is forced to reduce the nuclear size. If this reduction exceeds the limits of its functioning it must then disappear to give place to a new type, but if in the multicellular organism the old type of cell has assumed some functions strictly indispensable to the life of the whole organism, the deca-

dence of such cells causes as an inevitable consequence the death of the entire association.

In the struggle for existence which takes place between the tissues of the higher animals in the period of development and differentiation, the less differentiated tissues constantly tend to render the general conditions of nutrition incompatible with the multiplication of the more highly differentiated tissues, and finally, owing to the reduction of the nuclear equilibrium, incompatible also with their maintenance. Scarcely is the point reached at which the conditions cease to be adequate for the maintenance of certain tissues which fulfil an essential function for the association, when the final fate of the association is sealed.

On the basis of this idea, the accumulation of sclerotic tissues, as age advances, seems to be simply a special case of a vaster phenommenon common to all associations of cells which have to live in nutritive media of reduced volume. And since each cell which divides exhausts its autocatalytic capacity and returns to the initial phase of the autocatalytic cycle, that is to say rejuvenates, ROBERTSON believes himself to have reached by a different path a general theory of advancing age practically identical with that propounded by CHILD. According to CHILD it is the repeated process of multiplication, rather than the low degree of differentiation, which hinders in Protozoa the progressive course of advancing age and death. Each division produces a degree of rejuvenescence which compensates for the advancing age recorded in the interval between divisions. This takes place similarly in the case of higher plants, in which longevity may be attributed to the periodic renewal of the leaves and roots.

The considerable longevity of man, compared with other mammals, according to FRIEDENTHAL, is due to the great development of the nervous system, whence a high degree of resistence to inanition retards the effects of the progressive invasion of less differentiated types of tissues. He has shown that the proportion between weight of brain and body weight raised to a power of $^2/_3$ — factor of cephalization — varies from one animal species to another in proportion to the maximum possible duration of life. In man this duration, calculated on the basis of the *index of cephalisation*, is 80-150 years, which latter limit has effectively been reached in well ascertained cases of extreme longevity.

Further, numerous theories have been formulated regarding

the mechanism of advancing age starting from the idea that life is, in the ultimate analysis, the result of complex physico chemical phenomena. These theories so far are without secure experimental basis. According to LUMIÈRE advancing age would be due to the fact that the *colloidal* granules, ultimate physical constituents of living matter, augment progressively in volume with age, and consequently have in them a reduction of capacity of adsorption, and therefore of activity, which explains the progressive feebleness of vital manifestations in advancing age. But in consequence of the researches of LOEB and his school, which have shown that the colloids behave like the crystalloids, and follow like these the laws of chemistry, the phenomena of superficies and adsorption attributed to the colloidal state become secondary, compared with the predominant action of molecular reactions.

For others (PICTET) the mechanism of advancing age would consist, presumably, in the gradual transformation of the amino-acids with open chain into cyclic compounds, with consequent profound alteration of the cellular proteins.

A new and suggestive field of research on the study of advancing age was opened by the experiments of CARREL, who has shown the presence, in the blood plasma of young animals, of substances capable of promoting the development of tissues cultivated *in vitro*, while the plasma of old animals is almost free from such substances. The influence of age on the content of the serum in substances which actuate cellular proliferation is so considerable that CARREL and EBELING have proved that there is a definite relationship between the age of the animals which supply the serum and the acceleration of the growth of tissues cultivated *in vitro*. The juice of embryonic tissues shows itself to be particularly rich in substances which excite cellular proliferation, while in adult organisms the capacity to produce such substances is only preserved by lymphocytes.

As regards the depression of reproductive capacity of the more highly differentiated tissues found in organisms of advancing age, not to mention the mechanisms already described it seems probable that, at least in part, this should be attributed to progressive diminution of substances which excite cellular proliferation. The connective elements, being less exacting, as shown by experiments of culture *in vitro*, can continue the process of active multiplication, giving rise to sclerosis, even when the quantity of ex-

citing substances, furnished by the plasma, is no longer sufficient to stimulate the proliferation of the anatomical elements of the differentiated tissues.

These substances were called by CARREL " Trophonae ", but as their chemical nature is still unknown, it seems possible that we are not dealing with new hypothetical substances, but with the synergetic action of the hormones normally contained in the blood, which seem to become fewer with age.

This conception furnishes an explanation of the surprising phenomena of regression of sclerosis and renewal of proliferative activity in differentiated tissues, noted during the last few years as a consequence of the grafting of sexual glands in senile animals.

In the following chapters an account will be given of the present state of our knowledge of the physiological properties and the anatomic seat of the sexual hormones, of the biological effects of grafting and finally of the technique of the operation of grafting and other means by which it is possible to bring about rejuvenation.

II.

PHYSIOLOGICAL PROPERTY AND ANATOMICAL SEAT OF THE SEXUAL HORMONES.

The functional relations between the sexual organs and the other systems of the animal organism were noticed in fairly remote times. ARISTOTLE recognised and described the effects of castration on domestic animals, attributing to the testicles a function of great importance for the maintenance of vigour in males. The anatomists and physiologists of the Renaissance also recognised the very marked effects of the sexual glands, and especially of the testicle on the organism. But the testicle being then considered as an amorphous and semi-fluid mass, the secretions of which were derived from the bone-marrow and from the brain, a somewhat imperfect, but expressive interpretation was at that time given to this functional correlation, as is shown in the following passage from the work by SALOCCINI :— " The power and courage of man depends on the testicles, because from these parts issue subtile humours and vapours which mix with the spirits of our blood and of our nervous juices to generate our boldness and our vigour ".

At the beginning of the XVIII. century REGNIER DE GRAAF succeeded in showing that the testicle is formed of sinuous, fine, twisted tubes, in which the semen is formed. But to explain the general action exercised by the testicles on the organism, he admits the contemporaneous formation, in the tubes, of vapours — *aura seminalis* — which are spread through the other organs and cause the appearance of hair, the development of the larynx, and physical vigour. WITHOF, in 1756, attributed the effects of the testicle to the sperm in it which, re-absorbed, would represent a particular *stimulus* for the functions of the entire organism. This idea was later developed and elucidated by BROWN-SÉQUARD who thus expresses himself, after having illustrated the profound modifications produced by castration before the age of puberty :— " These facts and many others, clearly show that the testicles supply to the blood, either by re-absorption of certain parts of the sperm, or otherwise, principles which give energy to the nervous system and probably also to the muscles ".

With the recent development of the doctrine of the internal secretions, the action exercised by the sexual glands on the organism has been attributed to special hormones elaborated by them. Little is actually known of the real existence and the true nature of the sexual hormones ; however, it is possible to study some of their physiological properties indirectly.

The sexual hormones possess the general properties of the other hormones. They possess definite specific anatomical functional and non-zoological properties, since they act in a similar manner whatever may be the animal species which elaborated them. They are without antigenic power and hence they do not even cause phenomena of chemotaxis. They function as regulators of the metabolism of matter and energy without ever supplying energy.

Like the hormones of the thyroid, epiphysis and hypophysis, they exercise also a distinct morphogenetic action, to which is largely due the somatic sexual characters which in some species serve to distinguish the sexes. Of such characters, some — *genitalis subsidiariae* of POLL's classification — relate to the anatomic differences of the internal and external genitals in the two sexes. The others — *extra genitalis* — relate to other special marks and products of the soma, which in many animal species — Chordata, Arthropods, etc. — differentiate at first sight the male from

the female, by their absence or presence and by their different development and shape.

To this category belong some ectodermic organs :— *feathers, hair, teeth*; some dermoepidermic folds and papillae — *copulative papillae* of the Amphibia Anurae, *papillae of the glands* of some mammals, *crests* of tritons and of birds, *fins*, etc.; some cutaneous glands — *interdigital glands* of the Monotremata, *glands of the neck* of the Camellidae, etc. and also some cephalic appendages of Arthropods, and lastly the horns of mammals.

The morphogenetic action of the sexual hormone is also impressed on the osseous system, accelerating the processes of endochondral and periosteal calcification, and on the general development and the length and thickness of the joints, determining in many species considerable differences of bodily size between the males and females. Also the so-called "change of voice" which is observed in man at the period of puberty, and the song of some adult birds, have reference to the morphogenetic action of the sexual hormones. At puberty there is generally increase of volume in the larynx, enlargement and consolidation of the cartilages of the larynx and elongation of the vocal cords. In consequence, in the male, the voice becomes deeper and fuller, and, though in a less degree, also in the other sex it becomes stronger and more flexible. The selective stimulant action of the sexual hormones on the increase of the larynx is shown by the fact that in individuals of the human species, if castrated when young, the voice preserves the infantile tone, and in some animals — cock, horse — also, if castrated late after having been used for breeding purposes there is loss of voice.

The effects of castration, as also the modifications of the soma which follow the senile involution of the genital organs, have now made clear, on an experimental basis, the dependence of the somatic sexual characters on the germinal glands. In castrated animals the epiphyseal cartilages of the long bones remain active for a considerable time causing characteristic modifications of the skeleton and especially elongation of the joints. The internal and external genitals undergo more or less marked atrophy; some somatic sexual characters disappear, others regress and tend to approach the characters opposite to them, and in general the organism partly assumes the characters proper to the infantile stage. Only the Lepidoptera and a few other invertebrates are excep-

tions, as in these castration does not cause marked modifications of the bodily form. The somatic sexual characters, according to HERTWIG, TANDLER and GROSS as well as STIEVE, should be considered, at least in part, as characters of the species whose evolution is stimulated or inhibited, or otherwise regulated, by the internal secretions of the sexual organs.

The method of action of the sexual hormones in morpho-

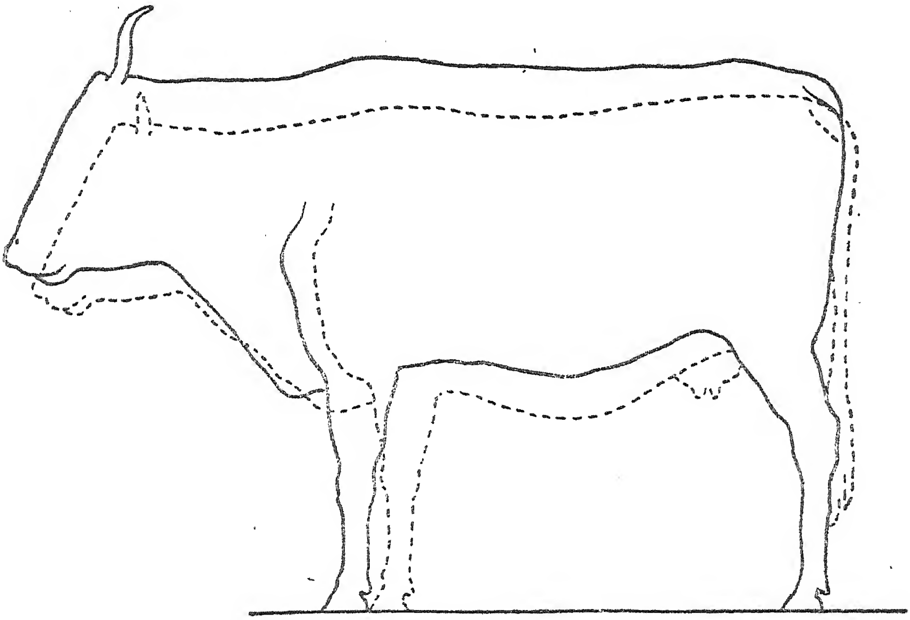


FIG. 35. — Conformation of the normal cow (dotted line) and of the castrated animal (continuous line). TANDLER and KELLER.

genesis is still obscure. However, CHAMPY, basing himself on some observations made on invertebrates and lower vertebrates, attributes to the sexual hormones an action essentially qualitative and capable of causing or exciting, in a way analogous to the effect of organic and inorganic catalysing agents in ordinary chemical reactions, the development of the somatic sexual characters; while from a quantitative point of view this development would be conditioned and regulated by the quantity of nutritive substances at the disposal of the organism.

The sexual glands with their internal secretions exercise, also, a definite action on the central nervous system and hence on the psychich life.

This action is made particularly manifest in the human species at the period of puberty, characterised by more or less profound modifications of the intelligence and by a complex of new aesthetic sensations which indicate the unfolding of the sex life.

In frogs the male, at the time of pairing, besides presenting peculiar anatomic and functional manifestations — callosity of the toes, croaking, hypertrophy of the muscles of the arm and forearm — shows a particular tendency to embracing with specialised claws, the so-called *amplexation or copulating* reflex by which it embraces and squeezes even inanimate objects. This reflex disappears with castration (NUSSBAUM, MEISENHEIMER, HARMS, STEINACH) but reappears in the castrated frog if injections are made of pulp of the nervous system of males in heat. STEINACH attributes the action of such pulp to the accumulation of the sexual hormones in the nervous system of males in heat and to the special stimulation which they exercise on the nervous centres and system. The mechanism of this amplexation reflex seems to be rather complex, being dominated by cerebral and cerebellar regulating influences (ALBERTONI, STEINACH and LANGHANS, BAGLIONI, SCHRADER) while it is completed in the medulla. It is, in any case, clearly shown that the nervous system may be directly influenced by the sexual hormones.

MAGNUS HIRSCHFELD, taking as proved the influence exercised by the sexual hormones on the nervous system and formulating the theory of intermediate degrees in sexual manifestations — Zwischenstufentheorie — admits a perfect parallelism between the biological phenomena and the psychic phenomena which relate to the sexual sphere.

He attributes, in fact, a strictly biological origin — deficiency and anatomical and functional anomalies of the genital organs — to psychopathic affections of sex — *homosexuality, androgyny, transvertism, metatrophism,* etc., and in general to all deviations of the sexual instinct which are met with in animals as well as in man. With this idea is connected the theory of the potential bisexuality of the sexual glands, by which the direction of sexual activity, and in general of desire, would be determined by the prevalence of the elements of one sex with respect to those of the opposite sex in the early stages of ontogenetic development, both elements being considered as normally present in the sexual glands. The sex of the sexual glands is, however, to be considered as irrevocably fixed at the

act of fecundation and is represented (KOHN) by the germinal cells which they are capable of elaborating.

STEINACH has endeavoured to give a satisfactory anatomic basis to this theory, attributing homosexuality to atrophy of the seminiferous tubes and to the presence in the testicles of homosexuals of large interstitial cells similar to the luteal cells of the ovaries, which he regards as interstitial cells of a female type — *F. cells* —. But this statement was not confirmed in its essence and its signification by many other investigators — HIRSCHFELD, STIEVE, HANSEMANN and BENDA and others. The facts however remains that the surgical cure of homosexuality advised by STEINACH and consisting in the removal of the abnormal testicles and subsequent grafting of normal testicles, in some cases (LICHTENSTERN, MUEHSAM, TIETZE-SCHREIBER) has given positive results in the sense that in the individuals operated upon, the return of normal desire has been obtained. Also in women prostitution and deviation of the sexual instinct seem to be bound up in many cases with facts of hyper-ovarism and of hypo-ovarism (VIDONI) or with anatomic and functional lesions of the genital organs due to pathological factors.

In the human species, however, the psychical phenomena which are related to the sexual sphere cannot be regarded in every case as strictly bound up with the internal secretions of the genital organs. Social life undoubtedly helps to increase in man through the abundance of external sensations the stimuli of a sexual nature. And these in turn concur to fix in the nervous system that complex of associations and of reflexes which constitute the psycho-sexual activity. It is however possible to admit in some cases the temporary deviation of the sexual instinct, under the influence of suggestion.

On the other hand, it is necessary to remember that other glands with internal secretions are important also in determining the sexual somatic and psychical characters, and that complicated correlations exist between the sexual glands and the other endocrine glands. Some of these — thyroid, hypophyses, cortex of the supra-renal bodies — are shown to have exciting function on the development of secondary sexual characters, and their action is synergetic with that of the sexual glands; others, on the contrary — thymus, epiphyses — are shown to have inhibitory action on the development of secondary sexual characters. It is found in fact that the thymus in the crisis of puberty rapidly atrophies

to a minimum which persists in advanced age, and that the destruction of the epiphyses causes a rapid bodily growth, while with castration before puberty and in the case of eunuchism, underdevelopment of genital organs, infantilism, etc., there is persistence of the thymus (TANDLER and KELLER). The mechanism of these synenergetic and antagonistic correlations is still obscure, but it is they which determine with their extreme complexity (KEHRER) the "*individual sexual formula*".

Opinions are divided as to the localisation of the endocrinal function of the testicle. ANCEL and BOUIN base their opinions mainly on the great prevalence of the interstitial cells in cryptic and in any way displaced testicles, in which spermatogenesis is suppressed, while the secondary sexual characters and the *vis coeundi* persist in a fairly marked manner in the individuals, and they attribute the production of the sexual hormones to testicular interstitial tissue and by analogy to the ovarian interstitial cells.

This idea was developed and confirmed by STEINACH and by his pupils in a long series of experimental researches on the effect of ligature of the *vas deferens* and on transplanting of testicles. In a testicle the *vas deferens* of which has been ligatured, as also in one transplanted, there occur profound histologic modifications which conduce to the degeneration of the seminiferous tubes, with more or less rapid atrophy of the germinative elements and considerable increase of interstitial tissue. Parallel with the disappearance of the spermatic tissue and the increase of the interstitial, the secondary sexual characters and the psychical characters of sex are heightened, and in the case of individuals of advancing age there is a revival, which may be transitory, of physical power and desire for the opposite sex. Atrophy more or less clearly defined of the elements of the seminiferous tubes and increase of interstitial tissue is found also in many forms of infection, in some forms of serious poisonings, in pathologic atresia of the *vas deferens* and even in chronic diseases with general denutrition. In these diseased states there may sometimes be loss of the *vis generandi*, but the disappearance or reduction of the sexual characters is never observed as a consequence of the regression of the germinal elements. In some cases there may be, on the contrary, increase of sexual excitability.

STEINACH has interpreted these facts as a fresh proof for the endocrine function of the interstitial tissue, to which he has assigned the name of puberty gland — Pubertätsdrüse.

PLATE VII.

FIG. 36. — Section of an ectotropic testicle of a grown-up man. (RETTERER).

This conception has been strengthened by the publications of various authors from 1912 to the present time, but the fresh knowledge acquired on the subject excludes, or at least leaves in much doubt, the supposition that the endocrine action of the testicle can be attributed to the elements of the interstitial tissue — LEYDIG's cells. LEYDIG's cells are fairly common in vertebrates and vary from one species to another in quantity, size and form. In some mammals — camel, horse, pig — they are much developed and occupy $^1/_3$-$^1/_5$ of the volume of the testicle, in birds they are often small, and in some fishes — Cyprinidae, Salmonidae — and in Amphibia — may be entirely lacking. In the foetal testicle of the higher vertebrates they are ordinarily very abundant, appear some time after the differentiation of the general outline of the generative part and tend to decrease towards birth. At the time of puberty there is normally an increase of interstitial cells with considerable individual variations. There are still greater variations between different species as regards the sexual cycle of adults, especially if it is a case of animal cycle or of intermediate cycle according to the distinction made by CHAMPY.

In many species there is no coincidence between the increase of interstitial tissue and the period of greater sexual activity. In others there seems to be parallelism between the development of interstitial tissue and the spermatogenic activity. In the Amphibia Anurae, FRIEDMANN and MAZZETTI have found coincidence between the greater development of the interstitial cells and the final phase of spermatogenesis. Similar observations were made by HANSEMANN, GANFINI, MARSHALL and others in hibernating animals, in which during *winter sleep* the interstitial cells diminish considerably in volume to increase again with the re-activity of spermatogenesis.

Such coincidences formerly supplied sufficient evidence for ANCEL and BOUIN to affirm the endocrine function of the interstitial cells. At present, however, there is a tendency to attribute a different signification to the variations of volume of the interstitial cells. Meanwhile, for some species it has not been confirmed that there is multiplication and increased volume in LEYDIG's cells in the final phase of spermatogenesis. For others, according to STIEVE, the parallelism between development of the interstitial and spermatogenesis is only apparent and erroneous, because it is necessary to take into account the very considerable variations of the total

volume of the testicle; it is known, for example, that in the mole, at breeding time, the testicle increases nine times in volume, and larger periodic variations are observed in birds, in which during the breeding season the volume of the organ may increase up to 300 times, and the weight even more. According to STIEVE in the crow, to the enormous variation of the mass of the generative tissue of the testicle, there corresponds, in the same sense, a minimum variation for the interstitial tissues.

Also, as regards the other variations of number and volume of the interstitial cells, noted by ANCEL and BOUIN, by STEINACH, by LIPSCHÜTZ and others, in cases of cryptorchidism, of ectopia, of transplantation, of ligaturing of the *vas deferens*, of radiation with X rays, of general disease, etc., it has been shown that for the most part they are apparent and cannot in any manner be generalized.

In cryptorchid testicles and generally in ectopic testicles, the seminiferous tubes are normally atrophied and the interstitial tissue appears to be increased in volume with respect to the diminished seminiferous tissue. The increase in volume is not however constant, some exceptions having been observed by FELIZET and BRANCA, BRUNI and others. It is moreover probable that the increase is only apparent, due, that is to say, to the atrophy of the generative tissue, the characteristic mitolic appearance which accompanies proliferative cellular phenomena not having hitherto been noted in interstitial tissue. On the other hand some cases have been described regarding subjects with testicles having absolute predominance of interstitial tissue, in which sexual activity (MAZZETTI, DÜRCK, BERBLINGHER) was strongly depressed or was entirely absent, and the secondary sexual characters were wholly or partly those of castrated animals. In transplanted testicles, as also in those with pathological atresia, and ligaturing of the *vas deferens*, and in those subjected to moderate action of Röntgen rays, there is atrophy of the seminiferous tissue with increase of interstitial tissue and persistence of the secondary sexual characters.

But in these cases as in cases of ectopia of the testicles or of regression of the germinal elements due to general disease or to seasonal dimorphism, according to STIEVE, there is never total disappearance of the epithelium of the seminiferous tubes. Regression mainly affects the germinative elements, which may be destroyed, while the epithelium persists, although reduced to

a single series of indifferent parietal elements and cells according to SORTOLI.

The probable secretive function of this epithelium cannot be denied *a priori*, particularly as, following the strictly morphological criterion, the internal secretive glands also, like those furnished with excretory ducts, should be considered as derived from a covering epithelium in which the epithelial elements acquire particular characters. This is a criterion which cannot be applied to interstitial cells, the probable connective-tissue origin of which is admitted by many writers.

The endocrine function of the epithelium of the seminiferous tubes, in opposition to STEINACH's theory of the puberty gland, is now admitted by numerous writers, including RETTERER, DIAMARE, BOLOGNESI, STIEVE, KENSSLER, CHAMPY, TIEDJE and others, and seems to find indirect confirmation from the fact that secondary sexual characters are also observed in some species unprovided with interstitial cells, as also from the great differences in appearance shown by the interstitial cells in different species, in contrast to the uniformity of structure of true glands with internal secretion and frcm the coincidence which is observed in animals with seasonal dimorphism between the final phase of spermatogenesis and the manifestation of the recurrent secondary characters.

From a theoretical standpoint there is nothing to prevent the function of the epithelium of the seminiferous tubes being at the same time exocrine and endocrine, and there may also be a heightening of the endocrine function when through special circunstances, for instance grafting, ligaturing of the *vas deferens*, atresia, etc., the external secretive function comes to be suppressed. As with the theory of the puberty gland, there is no direct experimental proof of the hormonic secretion of the seminal epithelium. STEINACH thought that it was possible to consider the cryptic testicle, as "isolated puberty gland" because composed largely of interstitial tissue. He did not, however, take into account, that whatever may be the predominance of that tissue, extensive tracts of epithelium always remain in the regressed tubes, forming a source of error, when recourse is had to injection of extracts or to grafting of cryptic testicles for the experimental renewal of the specific hormonic function of the interstitial tissue. More rigorous in any case is the technique proposed by BOLOGNESI, who with bilateral resection of the *epididymis* and *vas deferens* has succeeded in obtaining rapid and acute atrophy of the *didy-*

mis, with complete disintegration of the seminiferous tubes and hyperplasia and hypertrophy of the interstitial cells. But the transplanting of the *didymis* with completely reabsorbed seminal epithelium has not produced the reappearance of the secondary sexual characters in castrated subjects, and this negative experimental proof is not without value.

Recently BRUNI has succeeded in isolating the interstitial cells from the testicles of the horse and the ass, by freezing the testicles and cutting broad sections in the microtome and then beating up the sections rapidly and vigorously in water. With such treatment the seminiferous tubes are entirely emptied and the walls with connective tissue and interstitial cells alone remain, as is shown by the microscope. A first series of experiments carried out on castrated rats, with injections of aqueous-and alcoholic-ether extracts of these sections, did not give conclusive results. But in view of the value of the method, BRUNI's experiments ought to be repeated and extended.

In the present state of our knowledge the actual source of the specific hormonic secretion of the testicles is uncertain. An exception perhaps should be made with respect to the interpretation given by ARON to the so-called "glandular masses" found in the testicles of the Amphibia Urodelae. The glandular masses are formed in sacs emptied of sperms and result in a structure consisting of a central part due to the proliferation of SERTOLI's cells and of a peripheral part which has its origin in the differentiation of the connective tissue of the walls of the sacs.

In their genesis and evolution, as in their regression, these organs exhibit perfect parallelism with the seasonal variations of the secondary sexual characters. Such concordance was shown by ARON in numerous experimental researches, from which it is probable that the elaboration of sexual hormones in Amphibian Urodelae is due to the glandular masses of the testicle.

The knowledge acquired of the localisation of the endocrine function of the ovary is worth attention. In the ovary the cells of connective tissue origin, comparable with the interstitial cells of the testicle, have little importance, since they are entirely absent in many species and are never so abundant as those in the testicle, nor do they show as do the cells in the testicle, characteristic variations in volume, consequent on the action of X rays.

The endocrine function of the ovary in higher vertebrates has been attributed by BORN and by PRÉNANT to the *Corpora Lutea*, there being in many cases coincidence between the evolution of the yellow bodies and the appearance of hypertrophic modifications of the uterine mucosa and of the nipples. Later FELLNER, HERMANN and others noted that the therapeutic efficacy of the total extracts of ovaries in menstrual disturbances and in the menopause was due to the presence of yellow bodies in the ovary and their endocrine function has been fully and variously demonstrated by ANCEL, BONIN, FRAENKEL, LOEB, WESTER, BIEDL, UISKOUBINA and by many other investigators. It is probable that the atretic bodies and the so-called "interstitial gland roditory type" are analogous in function with the yellow bodies in view of the close morphological affinity which they have to these latter. The roditory type of interstitial gland, as is known, has no structural analogy with the interstitial tissue of the testicle. Such glands are generally found in the ovary of the Chiroptera, Insectivorae, rodents and of a few other mammals and are essentially constituted of yellow bodies in fibrous regression and atretic bodies.

III. BIOLOGICAL EFFECTS OF GRAFTING.

The biological effects of grafting are shown in all tissues of the animal organism and have a distinct effect on metabolism.

In males castrated and then grafted, there is restoration of secondary sexual characters, increase of muscular tone, thinning down, greater vivacity, return of desire and capacity to accomplish coition with emission of prostatic secretion. Corresponding results are obtained in spayed females; reappearance of female secondary sexual characters lost or attenuated by the effect of spaying, arrest of uterine atrophy, return — in anthropoids — of the menstrual cycle (STOCKER and UNTERBERGER, HALBAN); and with the implanting of the ovary in a suitable position, even pregnancy can take place (C. FOÀ, CHROBAK, GRIGORIEFF).

The grafting of fragments of the testicle in an entire adult male, or the transplanting of the testicle from the normal position to another — autoplastic transplantation — generally produces heightening of the sexual instinct and of the secondary sexual characters — *hypermasculinity*. These effects are more evident in young males under the age of puberty, grafted with mature testicles,

in which cases VORONOFF has observed acceleration of bodily development, precocious appearance of secondary sexual characters — especially hypertrichosis — premature ossification of the epiphysical cartilages, awakening of the sexual appetite. The thorax in these animals is wider, the muscular mass more developed, while a characteristic proportional lesser length of the joints is noted, due to the accelerated process of ossification. Similar effects have been observed in accidental and pathological cases of precocious puberty, by hypertrophy of the testicles (MARRO and SACCHI) or by hypertrophy of the ovary (H. THOMAS and HERSHMANN, HALLER, VERÉBELY).

In sheep grafted at a very early age — two or three months after birth — VORONOFF has noted a greater production of wool, the filaments of which became more abundant and considerably longer. In addition they have, *pari passu* with premature appearance of the secondary sexual characters, accelerated in development, which is translated into increase of bodily weight and consequently greater precocity in the production of meat. VORONOFF has endeavoured to give practical effect to these observations, recommending the substitution of castration by grafting, so as to obtain in young males a greater quantity of wool and meat.

It is still premature to give an opinion as to the practical application of pre-puberal grafting in sheep with a view to obtaining in the males an increased production of wool and meat. But the conclusions reached by VORONOFF, as regards the capacity on the part of the grafted males to transmit to their offspring a greater aptitude for wool production so as to be able to fix this character in the descendants in the course of a few generations, cannot be accepted, in view of the uncertain state of our knowledge regarding the transmissibility of acquired characters.

Among cattle, attempts have been made to increase, by means of grafting, the sex impulse in bulls where it is weak. (GRÜTER).

In man and in senile animals the effects of grafting and of other equivalent surgical interventions — homoplastic transplantation, ligaturing of the *vas deferens* — are still more noticeable and include a collection of data of the highest importance in the study of biology.

In senile rats, in which there is normally more or less marked atrophy of the external and internal genitals, thinness, slowness

PLATE VIII.

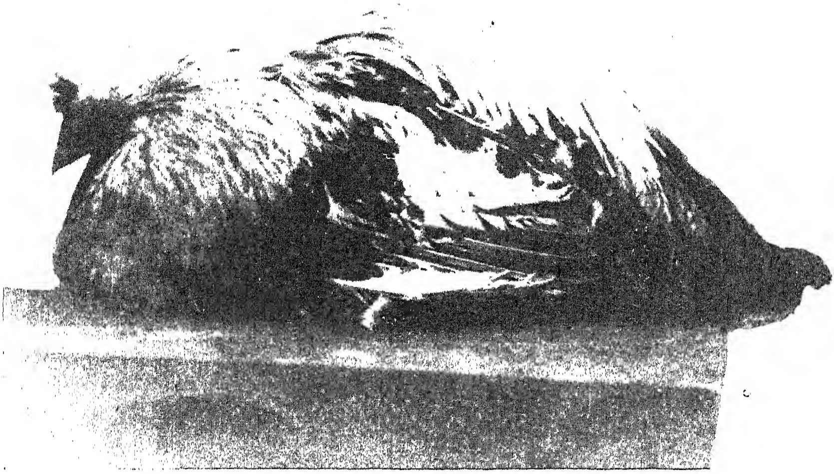


FIG. 37. — Cock in an advanced state of senility (MAYMONE).

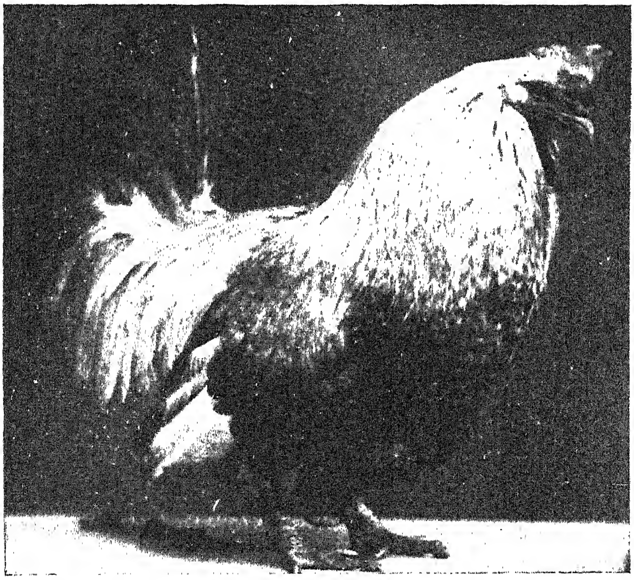


FIG. 38. — The same cock, 45 days after the endoperitoneal installation of the testicles of a young cock (MAYMONE).

PLATE IX.

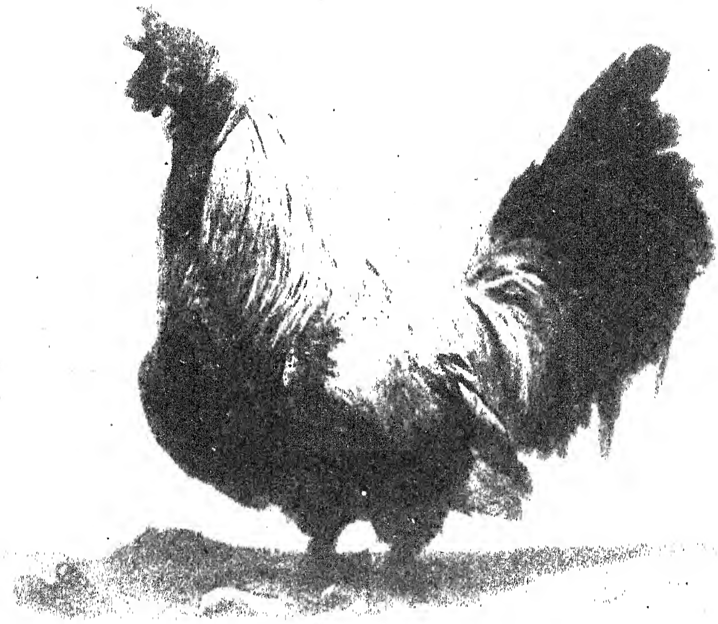


FIG. 39. — The same cock 5 months after the installation of the testicle (MAYMONE).

of movement, visual weakness, sleepiness, deterioration of the bony parts, particularly regarding the curvature of the spine, falling of hair, and frequency of cutaneous lesions due to parasites, STEINACH has obtained, by ligaturing the *vas deferens* and by grafting, a rapid improvement of the general condition, increase in weight, development of the muscular mass, straightening of the spine, regrowth of hair on the parts which had become bald, agility of movement, strong aggressiveness, return of the external genitals to youthful fullness and tone, reappearance of sexual appetite. These results have been fully confirmed in man and in other animals, by many experimentors (STEINACH, LICHTENSTERN, KAMMERER, VORONOFF, BRINKLAY, LYDSTON) and appear to overthrow the conception, hitherto dominant, of the non-reversibility of biological phenomena.

In a very successful case of homoplastic grafting of the testicle in an old cock, which had become thin, almost incapable of standing upon its feet and which for more than a year had lost the power of crowing, I also observed rapid and surprising improvement of the general condition, hyperplasia of the erectile organs for a long time atrophied, return of power of crowing, at first laboured and strident, then clear and powerful, return of the combattive instinct and of the sex impulse.

In his experiments of rejuvenation in man VORONOFF had noted, besides the external signs of rejuvenation, a notable improvement of the intellectual faculties, greater resistance to physical and mental fatigue, improvement of sight in long-sighted persons through increase of tone of the ciliary muscles, constant decrease of arterial pressure and in some cases amelioration of the symptoms of *angina pectoris*.

Often there has been, in old men grafted, the restoration of the *vis generandi* due to the restoration of spermatogenesis in senile testicles. But in many cases it has not been possible to conquer impotence by grafting, though the other effects of rejuvenation have constantly been obtained. Some of these effects — increase of tone in atrophied muscles, regression of arteriosclerosis, reawakening of intelligence, etc., etc., are truly surprising and justify a reasonable anticipation of the probable reversibility of some phenomena which characterize the bio-chemical and histological mechanism of old age. On the other hand, it appears probable that the endocrine action of the grafted testicle is explained through com-

plicated correlations and interrelations of secretions, affecting the whole endocrine system, which influence metabolism profoundly, causing, in the composition of senile tissues, nutritive modifications and dynamic effects. The intensification of metabolism in senile animals subjected to ligaturing of the *vas deferens*, or grafting was observed, among others by LOEWE, ZONDEK, VORONOFF and other investigators.

Similar effects are obtained in the case of females grafted with young ovaries furnished with *corpora lutea*.

Rejuvenation of senile organisms can be effected, provided that there are no serious endocrine disturbances or other irreparable pathological phenomena.

The attachment of the graft should be perfect and the piece used must be cut out of a young animal in a state of active spermatogenesis. The main element of uncertainty in rejuvenation lies in the duration of its effects, and the doubt as to whether a real prolongation of life is to be obtained by its means or not.

STEINACH in his experiments of rejuvenation of rats, which live on the average for 30 months, has obtained prolongation of life by 7-8-10 months longer than the " control " animals of the same group. On cessation of the effect of grafting or ligaturing of the *vas deferens*, advancement of age was greatly hastened in the rejuvenated rats, indicating that the organism had been subjected, by the effect of the rejuvenation, to intense strain.

The experiments of VORONOFF and others on man are still too recent to permit a conclusion to be reached regarding the duration of rejuvenation and the possibility of prolonging it by repeating the grafting on the return of advancing age. However, it cannot be denied that new and very interesting facts may be brought to light by extending the experiments of rejuvenation.

A field in which the biological effects of grafting have seemed to be remarkable is that of the crossed and heterosexual graftings. Grafting in castrated males of ovaries containing yellow bodies, if the graft holds, is noted by the intensification of the atrophy of the male genitals — penis, prostate, seminal vesicle — and pari passu increase of development of the nipples and the appearance of some secondary sexual characters proper to the female sex (STEINACH, KUND, SAND, STEIN and HERMANN). The males so femalised offer reflexes of enticement for normal males and are sought after by the latter like females. The development of the

nipples is, in many cases, so considerable as even to show stimulation of the lacteal secretion. In young females spayed and then grafted with testicles — masculinisation — there is marked regression of the uterus, of the nipples, development of the bony parts and of the muscular mass, similar to that of normal males, considerable hypertrophy of the clitoris and appearance of secondary sexual characters proper to the male sex. The psychical behaviour resembles that of the males; they follow the normal females and fight with the males (STEINACH, PÉZARD). Heterosexual grafting has greater probability of success in subjects castrated before sexual maturity. In the uncastrated the attachment of the heterosexual genital body seems to be hindered by the presence of the genital body of the host (STEINACH, SCHULTZ, C. FOÀ). The transplant often remains without effect in the invertebrates (MEISENHEIMER, OUDEMANS, PRELL). By grafting contemporaneously testicles and ovaries in castrated guinea-pigs and rats, STEINACH, has succeeded in producing true *experimental hermaphroditism*, which by the distribution of the somatic characters of the two sexes differs considerably from bipartite gynandromorphism, and approaches to the rare cases of natural hermaphroditism.

In artificial hermaphrodites, the stature, the bodily development, the disposition of the hair are influenced by the secretion of the testicle and assume male characters; development of the nipples — often rather marked — takes place influenced by the ovary, and the psycho-sexual behaviour shows itself variable, with periods of erotism of a male type and others of a female nature.

Another order of effects — hormonal sterilisation — has been obtained by HABERLENDT by grafting under the skin in female guinea-pigs or rabbits, ovaries of the same species in a state of pregnancy. In the subjects operated upon, the impregnated yellow bodies have produced effects of inhibition of ovulation more or less intense, which perhaps may have important clinical applications.

Included in the biological effects of grafting are also the attempts at surgical cure in homosexuality and in other sexual psychopathies.

In the experiments of grafting it was observed by HOUSSAY and LIPSCHÜTZ that very small fragments of testicle were capable of ensuring in the grafted animals the normal development of the secondary sexual characters. These researches renewed by PÉ-

ZARD with the aid of exact quantitative determinations of the degree of development of the erectile organs of turkeys, have led him to conclude that there is no parallelism between the mass of testicle grafted and the degree of development of the sexual characters governed by the internal secretion of the testicle. Thus, beyond the point at which the internal secretion begins to be sufficient to cause the development of the sexual characters there would not be quantitative relationship between increased secretion and the development of the sexual characters.

According to PÉZARD the endocrine function of the testicle would be responsive to the *law of all or none*, already recognised as true by MAREY for the cardiac muscle, the range of contraction of which is independent of the intensity of the stimulus, a maximum of contraction being found combined with a minimum intensity of the stimulus, and by VERWORN for the nervous fibre.

LIPSCHÜTZ in his experiments on guinea pigs and mice has proved that very small fragments of testicle, corresponding to 1-2 % of the testicular mass, are sufficient to assure the normal development of the sexual characters in grafted animals. CHAMPY has verified the applicability of the *law of all or none* in testicular grafting of frogs, and ZAWADOWSKI in birds. However this law does not lend itself as a satisfactory explanation of hypermasculinity and of eunuchism, and has not been entirely confirmed by STEINACH, VORONOFF, ARON and others.

An attractive field of enquiry is that dealing with the possible action of the internal secretion of the grafted generative tissue on the germinal cells of the host organism, and, in the case of total homoplastic grafting of the ovary in connection with the uterus, the chemical action of the host organism on the grafted ovary. We already know how difficult it is to influence the germinal cells by the action of external factors during the process of maturation, in the organs which envelop them. This difficulty represents the best defence of the species for the maintenance of specific characters and at the same time a fairly strong barrier to attempts at the creation of new species.

In the higher plants, well defined variations of general nutrition and specific variations have been noted, through the effect of grafting. But the transmissibility, when multiplied by seed, of the specific variations obtained by grafting, cannot yet be con-

sidered as definitely ascertained. The variations of general nutrition are shown by the increase and reduction in the normal development of the species to which the graft belongs, according to the stock used, with increase or decrease of volume of the fruit, of the content of saccharine matter, of acidity of mineral salts, etc. Thus, for instance, *Pirus communis* grafted on the quince tree — *Pirus Cydonia* — usually gives larger and sweeter fruit of a colour different from that obtained by grafting the same variety on pear stock from seed. The specific variations are still more significant and relate to the structural and botanical characters. Grafting *Licium barbarum*, a perennial plant with woody stem, on *Solanum lycopersicum*, an herbaceous annual plant, the stock itself becomes woody and perennial.

Other variations concern resistance to certain diseases, communicated by the scion to the graft; thus, e. g., the outbreaks of "gummosis" which seemed about to destroy the crops of *Citrus medica v. limonum* in Europe, could be effectively controlled by grafting this plant on *Citrus aurantium* v. *Bigaradia*, which shows notable resistance to "gummosis" and communicates this property to the graft.

Lastly, the so-called grafting hybrids, constituted by shoots which for the most part originate from the callus closing the wound of the graft, are of interest. These present the characters of the two individual plants superimposed and fused in a mosaic of elements of variable disposition — the septorial, periclinal chimerae and hyperchimerae of WINKLER.

The analogy between animal grafting and plant grafting is not, however, close, whether because in the latter there is constantly arterial anastomosis, or on account of the different distribution of the germinal cells in the animal organism and in plants. Certain experiments would however suggest the possibility of influencing animals by external stimuli of the germinal cells in such a way as to cause the appearance of variations in the descendants.

Putting aside the classical experiments of HERTWIG, who succeeded in causing in the descendants the appearance of anomalies by irradiating the sperma of frogs with Röntgen rays, HART's experiments are specially interesting. He succeeded in transmitting to the descendants a new form by means of extirpation of the thymus in the parents. GROTE, again, reports that by feeding white

mice, before mating, with thymus, he obtained in the young a distinct inhibition of development in the first weeks of their life, and that in mice born to parents fed with extract of the thyroid gland he obtained a greater development than normal. The possibility of influencing the germinal cells by the action of the glands with internal secretion is also confirmed by TANDLER, and from this point of view homoplastic and heteroplastic grafting of sexual organs constitutes a valuable method of research.

IV. THE IMPROVEMENT OF OPERATIVE TECHNIQUE AND THE SURVIVAL OF THE GRAFTED TISSUE.

The first attempts at grafting testicles date from remote times. Already in 1767 HUNTER, studying the differential sexual characters between male and female in domestic fowls, had attempted to graft the testicles of the cock on the hen; these researches were renewed in 1849 by BERTHOLD, who succeeded in transplanting the testicles of the cock into the peritoneal cavity of capons, obtaining the reappearance of the secondary sexual characters, lost through the effect of castration. There followed the confirmation by WAGNER in 1851, and by NUSSBAUM, MANTEGAZZA, HERLITZKA and SALACHAS, as regards frogs and of LODE, FOGES and PÉZARD, as regards birds.

On account of the greater difficulty which it presents, grafting of testicles in mammals was carried out later by MAXIMOW, RIBBERT, MAUCLAIRE, ZALACHAS, CEVELOTTO, STEINACH and others, Grafting of the ovary, successfully attempted by MEISENHEIMER in frogs, was subsequently applied in human surgery to lessen the effects of spaying in women by MORRIS, UNTERBERGHER and PAKOW, and in animal species for research purposes. The operative technique of grafting, in recent years, has made considerable progress, especially through the work of VORONOFF. The possibility of the success of heteroplastic graftings has been widened and attempts even made to reconstruct the dissected spermatic channels.

The ligaturing of the *vas deferens*, radiation with X-rays and the injection of testicular and ovarian extracts have also been largely used for the exaltation of the sexual instinct and for rejuvenation.

The great difficulty in the case of the attachment of testicular grafts in mammals lies in the impossibility of ensuring

arterial anastomosis so that the grafted piece is supplied with a normal flow of blood in its new seat. CARREL has succeeded in obtaining anastomosis of the arteries in some grafts of entire organs — kidneys, thyroids — made on dogs and cats. But for the testicles the difficulty is almost insuperable, owing to the rather narrow calibre of the arteries, and it is necessary to be content with ensuring a rich supply of plasma for the nutrition of the grafted piece, until with the establishment of adhesion there is a re-establishment of the peripheral capillaries. Starting from this idea VORONOFF proposed to make the graft within or over the serous coat of the testicle, suitably scarifying the seat so as to cause a plentiful extravasation of blood and to stimulate the formation of adhesion. For the graft he preferred fragments of testicle in which it is easier to assure nutrition with plasmatic exudation and with establishment of capillary circulation, rather than the entire organ — the total grafting of the testicle of LIDSTON, ENDERLEIN, LICHTENSTERN, THOREK — which often results in rapid necrosis.

The other methods suggested for grafting differ essentially in the seat — subcutaneous connective tissue, peritoneum, muscular tissue — in which transplantation has been done. LYDSTON has transplanted entire human testicles into the *scrotum*, practising grafting of the *vas deferens*. LESPINESSE grafted fragments of testicles on the *rectus* muscles of the abdomen, ENDERLEIN on the *subcutaneous connective* tissue of the abdominal region, MORRIS on the *sheath* of the rectus muscles, LICHTENSTERN on the raw surface of the *oblique external muscle* of the abdomen, GREGORY in the *recess* between the superior and inferior oblique muscles of one side and the transverse muscle of the other, THOROK directly on the *peritoneum* below the abdominal muscles, and in the peritoneal cellular muscles, by means of a lumbar incision similar to that made for nephrectomy.

The attachment of the graft has varying probability of success according as it is a case of autoplastic and homoplastic transplantation, or of heteroplastic transplantation. In the former cases which deal with tissues belonging to the same autoplastic organism, or with individuals of the same species, the transplant has greater probability of success. However to improve the conditions of attachment in autoplastic grafts, STEINACH advises transplanting the testicles in the peritoneum and in the abdominal muscles leaving them

in contact with the spermatic cord for some days to assure the vitality of the organ in its new seat.

The heteroplastic grafts are difficult of attachment owing to the limited chemical characteristics of animal organisms. In the human species heteroplastic grafts with ram's testicles have been attempted with some success by STANLEY and KELLER and FALCONE, and grafts with testicles of anthropomorphic monkeys by VORONOFF and DARTIGUES. The latter have given a high percentage of attachment and have been suitable for practical application, owing to the great biological affinity between human blood and that of the anthropomorphic monkeys. In the transplantation of sexual glands, as direct anastomosis of the blood arteries is absent, it is not possible to get true, definitive attachment of the grafted organ or tissue, which sooner or later becomes reabsorbed and replaced by connective tissue of the host. Embryonal tissues alone appear to be capable of definitive attachment preserving their own structural and specific characters — HARRISON, BRAUS, SPEMANN.

The duration of the secretory activity of the grafted fragments of testicle, hitherto observed, has been about 10 months for the heteroplastic transplant in rats (STEINACH), which live on the average for thirty months, and three or more years (VORONOFF) for Etero-plastic grafting in man, with testicles of anthropomorphic apes. The possibility of obtaining longer survival with improvements in operative technique is not, however, excluded. RETTERER admits that in the fragments of testicle grafted, only the superficial strata, impregnated with nutritive plasma, continue to live, while the deep strata, in which all circulation is interrupted, suffer rapid necrosis and reabsorption. In the superficial strata, through the effects of the changed conditions of nutrition, the constituent anatomic elements, especially the epithelial cells, change their structure and their evolutive cycle. The epithelium of the seminiferous tubes continues at some points to produce small nuclei and heads of spermatozoa, but the greater part is transformed into a mass of cytoplasm containing numerous nuclei, which develop by successive cellular divisions, forming a reticulated connective tissue of narrow mesh full of translucent plasma. Subsequently the meshes may become wholly or partly empty of plasma.

RETTERER attributes to the production and reabsorption of

PLATE X

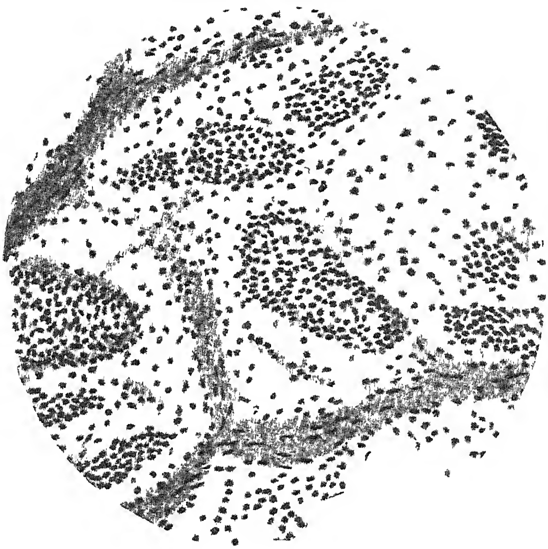


FIG. 40.—Section of a buck's testicle, one year after installation (RETTERER).

this plasma elaborated by the epithelium of the seminiferous tubes, the influence exerted by the grafted testicle on the other tissues of the organism, but regards the increase of volume of the interstitial tissue as merely apparent since he has never observed proliferative action in LEYDIG's cells.

STEINACH has, on the other hand, observed in grafted testicles rapid disintegration of the seminal epithelium, followed by considerable hyperplasia and hypertrophy of the interstitial cells. This statement was confirmed by numerous investigators, but it is probable (BOLOGNESI) that the disintegration of the seminal epithelium is the reabsorption of the seminiferous tissues which have arrived at the maximum degree of atrophy, rather than a true necrobiotic process caused by the lesion of the grafted organ. As regards the increase of the interstitial cells, at least in many cases, it must be admitted (STIEVE) that it is a case of relative and not absolute increase.

In ovaries grafted subcutaneously in the abdominal cavity there is as a rule early atrophy of the immature follicles and formation of fibres of interstitial tissue. Cases are however not lacking in which the maturation of some follicles and even pregnancy are obtained, if the graft has been made in a suitable seat.

The interruption of the spermatic channel by resection or by simple ligaturing of the *vas deferens*, causes, according to ALESSANDRI, ANCEL and BOUIN, STEINACH, MARTINI, SAND, TANDLER and GROSS, atrophy of the testicle, reduction of the calibre of the seminiferous tubes, degeneration and disappearance finally of epithelial tissue and *pari passu* considerable hyperplasia and hypertrophy of the interstitial cells. As a consequence spermatogenesis goes on decreasing until it completely ceases.

According to RIBBERT, FABBRIS, MARCHI and DIAMARE, UFFREDUZZI and others, the ligaturing of the *vas deferens* does not always cause atrophy of the testicle and consequent suppression of spermatogenesis. MARRASSINI thinks that, by itself, ligaturing the *vas deferens* would not produce considerable atrophy in the testicle. This would, on the other hand, be due to lesions caused while isolating the *vas deferens* from the surrounding connective vascular-nervous sheath which latter should not be included in the resection. It is known, that without interruption of the spermatic channel, there may be considerable atrophy of the testicle and degeneration

of the seminiferous epithelium due to the ligaturing in mass of the arteries of the funicle and to the resection of spermatic plexus and that of the *vas deferens*.

Guizzetti has shown, on the other hand, that in some congenital anomalies with occlusion of the *vasa efferentia* the seminal epithelium can reconstitute itself normally and produce active spermatogenesis. The histologic modifications, which are found in testicles with interrupted spermatic channels, are generally due to the compression exerted by the sperms inside the tubes and to slow reabsorption by lymphatic channels. The effects of the compression (Stieve) vary according to the age of the seminiferous tissue. In young testicles in active spermatogenesis, the compression exerted in the tubes by the arrested secretion may be strong enough to cause intense degenerative action at the expense of the seminal epithelium, while in testicles of the old with depressed but not entirely extinct spermatogenesis, the moderate pressure which is established by the effects of the occlusion of the *vasa efferentia* excites spermatogenesis and reactivates the endocrine function of the tissue.

Histologic modifications, similar to those caused by ligaturing the *vas deferens* are also obtained with moderate exposure to X-rays — C. Schmidt, Albers, Schönberg, Bergonié, Tribendeau, Villemin, Kyrle, Tandler and Gros.

In the case of testicles exposed to irradiation there are more or less profound modifications of the epithelium of the seminiferous tubes, especially at the expense of the elements of the seminal tract, spermatogonia, spermatocytes, cessation or diminution of spermatogenesis and considerable increase of the interstitial cells. If the irradiation is moderate, the epithelium easily regenerates the elements of the seminal tract, probably at the expense of some spermatogonia which have escaped destruction, and spermatogenesis may be reestablished. If on the contrary the irradiation has been excessive, Sertoli's cells also, which are the most resistant of the epithelial elements to the action of the rays, end by being destroyed, and there is complete loss of spermatogenesis (Kyrle) while the interstitial cells become hypertrophic and show greater resistance. The irradiation of the ovary is at present widely used for the cure of climacteric disturbances in women by Halberstätter Heineke, Bouin, Ancel and Villemin, Tribendeau, Simon, Steinach and Holzkencht, Biedl, Stieve and others. In the

ovary subjected to moderate exposure there is cessation of ovulation, regression of the immature follicles with formation of black bodies and persistence of the yellow bodies. In a corresponding manner the irradiated females show hypertrophy of the uterus as in pregnancy, considerable development of the nipples accompanied in many cases with lactic secretion and exaltation of sexual instinct. Similar effects might even be obtained in senile females in whom the considerable improvement of general physical health indicates a true and genuine rejuvenation. A still more decisive simplification of the proposed rejuvenation treatment might be obtained by substituting for surgical operation the injection of testicular and ovarian extracts, already suggested by BROWN-SÉQUARD in the classical auto-experiment, which was the fore-runner of opotherapy. Opotherapeutic treatment might find its reason for existence and the probability of wide practical application, in the fact that the specific action of the sexual hormones, as in the case of all known hormones, is essentially anatomic and physiologic, and not zoologic.

The introduction of compound extracts of testicles and ovaries, even if cut out with due aseptic precautions, is not however free from serious risks. In the extracts, apart from the non-antigenic hormone extract there are contained numerous antigens with a certain degree of toxicity represented by the protein of the anatomical elements and by products of their autolysis. These antigens, independently of the effect produced by the sexual hormones, can exert an action of their own, masking and modifying that of the hormone. The toxicity of the extracts will be further considered from the point of view of the phenomena of anaphylaxis which may occur and from the point of view of the cytolysis produced which might exert a widespread injurious action on the elements of the live organ corresponding to that from which the extract was taken. It is perhaps due to the great complexity of the effects produced by the extracts that the results obtained with their administration have not always been consistent.

In very successful cases of injections of testicular extracts in castrated individuals (NUSSBAUM, DOR, MAISONNEUVE and MEURIDES, PÉZARD), and of injections of extracts of ovaries with yellow bodies in females (FELLNER, HERMANN, ASCHNER, OKINTSCHITZ and GAVIN) the reappearance of lost sexual characters was obtained, as by transplants. The action of the extracts is however of

very short duration and disappears with the cessation of their administration. It should not, however, be forgotten that with improvement in the technique of preparation of the extracts their toxicity may be reduced and they may be rendered more effective and constant in their action, as has already happened for other opotherapeutic preparations largely used in clinical practice. Essays in this direction have been made by PARISER with the manufacture of "Rejuven", by BERTARELLI with the manufacture of "Inter", and by others. But the results obtained up to the present are not very reassuring. The knowledge obtained shows that the mechanism of old age, though still hypothetical, may be attributed to progressive exhaustion of reproductive capacity of the anatomical elements of the differentiated tissues.

The grafting of regenerative tissue in animals of advancing age, and the other operations capable of stimulating the endocrine function of the sexual glands, undeniably cause a transitory stage of rejuvenation, which can be prolonged by improvement of the operative technique and by repetition of the grafting, but of which the effects on the economy of the senile organism have not yet been sufficiently defined. The mechanism of rejuvenation is obscure; it may however be considered probable that the sexual hormones cause directly or indirectly the synergetic action of other endocrine glands and of special nervous reflexes, having as a final result considerable increase of metabolism and renewal of proliferative activity in the anatomical elements of the differentiated tissues.

In the field of general biology the grafting of generative tissue constitutes a valuable method for experimental research on interesting problems which relate to hermaphroditism, sexual neutralization, acceleration of development in the period previous to puberty and especially the possible effect of the grafted tissue on the hereditary characters of the germinal cells of the host.

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NEW TENDENCIES IN THE GENETIC IMPROVEMENT OF LIVE STOCK.

It is evident that the improvement of living beings cannot be attempted without a knowledge of the complicated problems of their variations and inheritances which form nowadays a new and important branch of science known by the name of GENETICS under its two aspects, relating to plant and animal life. It is also evident that living beings transmit to their progeny the characters which we call hereditary. But here already it is necessary to make a distinction. All that is constitutional is hereditary, if we may say so; thus for instance the nose, with man, the lungs, the kidneys, etc. This kind of inheritance, which might be called a constitutional one, does not concern us, in a general way. But within it there exists a new kind of heredity, since the form and even the size of the nose may be hereditary (as will happen in the cases of hereditary giant and dwarf characters), although such, size and form may not be hereditary if obeying as wellknown and as universal a phenomenon as is variation or fluctuation. For many observers this problem constitutes a stumbling block when, while not sufficiently distinguishing one case from another, they claim to fix in the offspring a character not hereditary, as being a product of external conditions, which only modify living beings from an individual and never from a hereditary point of view.

So that if in selecting we choose as a norm the most frequent variation which is that produced by the surroundings, we should make the serious mistake which is made by the greater part of those who write on Zootechnics.

This *non-heredity* of variations or fluctuations which is now admitted by the most important biologists, gave the deathblow, twenty years ago, to that theory of evolution which was propounded first by Lamarck and then by Darwin and popularised by them.

Accordingly, it is an error to believe that it is possible to select live stock by the well-known methods of Kramer, Lydtin etc., which consist in taking numerous measurements of the animal, all of them subject to non-hereditary variations or fluctuations. No improvement can be expected in the progeny by this method.

As a matter of fact it is not possible to admit that any animal

will be more useful, or that e. g. a cow will produce better and more milk, if its measurements coincide more and more with the theoretical scale of the maximum of points.

Any one could prove the uselessness of such relations in the measurements of the animal (1), because they correspond to a simple fiction as to the value of correlations.

The modern research work on the phenomena of correlation in animals — executed with a mathematical exactness hitherto unsuspected — cannot recognise the conclusions which were too hurriedly adopted in reference to the criteria here under discussion. I can guarantee that in the Dairy Cow Test organised by me at Ribadeo in June 1924, the cows which obtained medals as the best producers of milk and butter would not have won a single medal if the method of classification had been employed which is based on the bodily measurements of the animal. And it must besides be kept in view that there were 16 competing cows; that the test lasted for eight days; that each of the three daily milkings and also the stock feeds were tested in an exceedingly precise way... The North Americans are used to say with much acuteness in this respect that perfection of form in a cow is not an obstacle to her producing much milk...

I am far from denying the positive utility of an external examination of the animals. It is evident that a good dairy-cow must have fine udders and that a brood mare meant for reproduction must possess the necessary width of frame required by her function.

No one, of course, can deny this contention, but surely the estimation of these characters should not be exaggerated, as it is well known that there are cows with very fine udders that, notwithstanding, give very little milk, and exceedingly well built mares that produce a small offspring. So that *a posteriori* we may always be sure of taking a reasonable view of the problem, whereas, if we proceed *a priori*, we cannot be sure.

(1) One of the first to raise his voice against the so-called method of measurements and points was the German professor E. Pott who, as early as 1889, published an immense work — mentioned in the bibliographical notes inserted at the end of this article — which more than ever serves to prove the unrivalled acumen of the German author, violently attacked though he was by his contemporaries. The following paragraphs are taken from this most important book. He says: "Who can prove or believe that the only wel lbuilt Dutch bulls are those which have a trunk length of between 185 and 195 cms., with a uniform height of 142 to 145 cms. from the back to the rump, and a chest depth of 80 to 85 cms. together with a chest breadth of 60 cms ?.. ".

The following words too are worth consideration: "No doubt the stock-farmer may by means of the measurement method obtain some external resemblances in his herd, but will these resembling animals show the same resemblance in their functions ?.. "

No doubt the ideal achievement would be to combine perfection of form with a high economic value of the animals, and selection and breeding should be carried on in this sense. I believe, however, that it is more necessary to obtain first of all the perfection of the function, instead of looking for perfection of form, and that after having selected certain animals for their functional qualities, one may then begin to look for all sorts of imaginable beauties....

In certain cases beauty of form has a certain economic value which should not be ignored here. Such a case is that of "fancy-horses" — every day less in demand, however — which must, as far as possible, possess special external qualities. It cannot be denied that in this case beauty of form is to some extent hereditary (though not all the progeny of well-built sires are well-built themselves), as it is well known how rigorous a *selection* is made of these animals, in our Andalusian regions, for instance Besides, since the efforts expected from horses of this kind are always less than their actual powers, only a certain standard is as a matter of fact looked for. The end desired is not that of a minimum functional organic yield, as in most other cases, and therefore the harmony of the animal's measurements plays a most important part in its valuation.

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Modern zootechnical tendencies take no account of imaginative theories and are based entirely on data derived from the experimental field, because in positive science nothing counts in comparison with facts themselves rightly interpreted — *facta et verba*..... The strictness of method achieved by investigators is a wonderful thing and the severity with which they sometimes judge their own work is admirable. Hence this modern science of Genetics carries with it extraordinary guarantees.

The improvement of our live stock may nowadays be undertaken, thanks to the discoveries made in plants by Mendel and by Johannsen, those great names of present day Biology. The methods of operation are identical for plants and for animals apart from the differences established by Nature.

In order to state on general lines the method of procedure, it is advisable to keep to one example which, for greater interest, may be taken from cattle. Let us assume that the selection is undertaken with a view to milk yield.

To this end it is necessary in the first place to keep under observation a large number of animals, the more the better. The aim of this observation is to effect milk records, which is not an easy matter. By these milk tests the quantity of milk given by a cow from the 72 hours following calving to the end of its lactation period is recorded and the fat content in the case of each animal is tested.

The experimental facts justifying milk tests may be expressed in the following way:

1. The examination of external characters does not furnish a correct criterion for estimation of milk production.

2. High milk yield is much more an individual quality than a matter of racial heredity.

3. High milking aptitudes are capable of transmission by inheritance.

The first step, thus, is to establish milk records. A true system of milk records registers the entire lactation.

There are, however, various ways of carrying out these tests by which partial data are obtained. As none of these methods are free from error, in each case the method most suited to the particular case should be ascertained. I have seen the control carried out in Belgium, in Switzerland, in France, in Germany and in Italy in very different ways, and though this is not the place to give a detailed account of the technique, it should be said that while in some localities the milking control is effected in the American way over seven consecutive days, in others — as happens in Belgium — it is considered sufficient to register three series of daily milkings: at the end of the second month of lactation, at the end of the fifth month and at the end of the eighth.

The tests can also be carried out in the farms by collecting all the animals, or on the small holdings by going from one to the other and doing the milking and weighing of the milk and taking at the same time the samples for its analysis. Both methods are employed according to local circumstances.

It seems natural to obtain more reliable data in the farm on account of the greater number of safeguards and because the control of feeding can be done under better conditions. In a general way and when the control must be done from house to house a person of approved character must be chosen as tester. To make him acquainted with his duties is a question of a few days.

Let us now suppose that we have chosen the best cows of a

rural zone; what remains is the more arduous part. The sire is still to be found who can conveniently be mated with the chosen dams so that the progeny may be what we are looking for. Nor can this choice be made in an arbitrary way, i. e. by simply measuring the body of the animal. It must, on the contrary, be done *a posteriori*, experimentally, and here the rules are difficult to state, because in every case the experimental proofs will have to be adjusted to what the person aiming at the improvement thinks suitable. I myself have learned that one must keep in direct touch with realities in order to ascertain and to overcome the numerous difficulties presenting themselves. It is not possible, for instance, in our case, to judge any sire of less than four years of age. To be convinced of this it is enough to calculate the time passed between the first service by the bull and the first lactation of his progeny. As the cows chosen may belong to at least two different categories according to their being pure dairy cows (which is not probable) or to their possessing a milking value due to hybridisation (which is the most frequent case with cows which have won prizes in milking competitions) the aim of the experiments made with the sires will be to verify these extremes. Therefore it is impossible here to specify the suitable method, which besides would be a task of some magnitude.

There is, however, a rule for recognising a bull which is the bearer of good aptitudes: namely, when the daughters of this sire are better milkers than their dams, we may almost certainly affirm that the increase of milk or butter is due to the sire. But this does not absolutely hold good in a general way, for reasons which it would take too long to explain. We may now consider that the groundwork of our zootechnical system is laid, and yet the greater part is still to be done, because at this moment there begins the real work of the specialist in Genetics, a work which evinces amazing skill and conscientious care in its progress and its results. Now is the moment to proceed with the consanguineous matings which fix the characters, to arrive at the pure lines which are the goal of our efforts.

Here too is the moment to discard many prejudices cherished by the general public as regards consanguinity. This is perhaps the strongest lever at our disposal for the improvement of animals and plants. Consanguinity creates nothing in progeny, neither for good nor for evil, as is generally maintained nowadays. Consanguinity is the "biological sieve" that severs what is useful from what is harmful,

for consanguinity does nothing else. To this might be objected that there exist numerous cases which prove the harm done by unions effected between kindred, but the answer may be given that there exist just as many which prove the contrary, though it is but logical that the former cases should attract more attention.

Moreover, just as the laws of heredity were mathematically formulated by GREGOR MENDEL, it is curious to observe that in studies upon consanguinity numbers play a most important part. A large part of the higher mathematics which we study in our Engineering Schools is perhaps much more applied to the study and practice of consanguinity than to current engineering. If we add that in Genetics the theory of probabilities is indispensable, it will be understood how great a complexity is involved in these problems.

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The following resolutions were presented to the first Congress of Regional Economy at Lugo by Don Cruz A. Gallastegui, Director of the Biological Mission of Galicia, under whose direction I studied, and myself. They were approved without discussion.

(1) It is of the first necessity to undertake the improvement of live stock if we want to compete on the markets of meat and, particularly, of milk products.

(2) With the present State organisation of mounting stations — for horses, swine, cattle, etc. — the problem cannot be solved.

(3) To obtain the improvement of our live stock it is necessary to have establishments in which large numbers of live stock may be handled, or to transform the existing ones.

I do not think that the foregoing conclusions will be a surprise to any one. As a matter of fact the first of them contains a truth only too evident to all, as it proclaims the necessity of the improvement of live stock. As to the second conclusion, it is easily seen that with the present mounting stations the methodical practice of consanguinity is made impossible, not only because the genetic constitution of the dams is not known, but also because the sires brought from outside the station are more numerous (1). The ideal thing would be that any one sire should only serve the females belonging to the same pure

(1) HAUSHALTER is right in saying that it is no use to import breeding animals descending from dams yielding six thousand and seven thousand litres of milk, if the offspring do not yield more than two thousand litres.

line, as, in this way, the progeny could be absolutely guaranteed. And this consideration is the necessary link leading to the last conclusion, because it means that the farmer must be furnished with the sires and dams which suit him, already selected. It is illogical to furnish him with selected seeds and to deny him the same facilities with live stock where selection is much more difficult.

But what seems an entirely justifiable desire can only be attained if large numbers of live stock can be handled at one time, and this for two reasons: firstly so as to obtain a greater number of selected animals as a starting point, and secondly because, as soon as the characters are fixed, there will exist a considerable number of animals to be assigned to the farmers. Our actual farms do not, for want of means and of working facilities, possess more than twenty or twenty-five head of cattle, an absurdly small number if any improvement is to be achieved. It might be objected that the Basque Provinces have succeeded in improving their cattle stock by means of mounting stations. This is true in so far as they have supplanted the breed of their own country by other animals that give more milk and more meat. But by the method they have followed of crossing the Basque red cows with the sires from Schwyz they have only achieved an apparent uniformity, because in their cattle there may be observed anew considerable differences in the economic aptitudes, not only in precocity, but also as to milk yield which shows that the speedy improvement of the breed under scientific direction should be undertaken. By following a better method the Basques would now have had an improved indigenous stock which they might exploit simultaneously with the selected breed which would best have suited their requirements.

In the province of Santander the mistake made comes from the method followed — though it is quite different from that employed by the Basques — in that, together with the males, they imported numerous females. These cows, called *ship cows,* come directly from the Netherlands.

It is a proved fact that these imported cows are excellent milkers and that their daughters are much less so, whereas their granddaughters produce still less milk than their mothers. The breeders of the province of Santander, following, no doubt, the opinion of some technician, believe — erroneously — that this "degeneration" or diminution of milk production is due to a phenomenon of influence of environment hereditarily transmitted in a progressive way. It

is not to be wondered at if the belief in this error lasts on, as it is simply due to a superficial and ordinary conception of the problem. The Santander breeders believe, in a general way, that the *ship cows* are pure animals, because they are of the same breed, distinguished by a definite uniformity of exterior — colour and skeleton, chiefly. They do not imagine that beneath identical external characters there really may be numerous animals entirely different as to their capacities. But there is still more : the *ship cows* are hybrid products of the first generation — giving to this expression its scientific sense — and as such they present the characters of hybrid strength — in this case, increase of yield — well known to any beginner in Genetics. And so it is only natural that in mating these first generations imported from the Netherlands, Mendelian disjunction — not reckoned with by the Santander breeders — occurs, giving rise to offspring of less milking value.

Even if the imported animals were homozygotic, it must be remembered that they would not all be so in regard to the same characters, and then if two different homozygotic animals were mated, the offspring would be hybrid, which would lead us back to the preceding case.

So the necessity becomes evident of knowing the genetic formula of every animal in order to be able to regulate in every single case the matings which cannot be left to arbitrary solution.

Correct breeding methods would prove that the so-called " degeneration " is one of the numerous myths which disappear when the problems are presented in their real terms.

The foregoing statements simply show that in the Netherlands the breeders know how to provide the markets with animals which are good producers of milk but bad producers of offspring which enables them to make an easy and lucrative profit, a fact to which we are still blind in Spain.

If it is certain that the improvement of live stock and of plants can only be achieved by putting into practice the experimental teaching of modern Genetics, it is readily understood how small must be the value of all that is being preached or written outside the range of this science.

Hence arises the necessity for exercising official action on zootechnical establishments with proper direction so as to avoid useless waste of time and money.

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INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

INFLUENCE OF MANURES AND MICRO-ORGANISMS ON H-ION CONCENTRATION IN THE SOIL.

According to theories expounded by Professors LORENZ and LARMOR, the constitution of chemical atoms is that of a positive centre, surrounded by a considerable number of electrons, the algebraic sum of the electric charges of the atom being zero. It has been suggested that these electrons gravitate round the centre and constitute a system similar to a collection of planets gravitating round a star. Cannot what has been said of the atom be said of the molecule ? In the case of a molecule of benzene, for example, do we not conceive a system of many centripetal forces whose resultant is zero ? Any such striking analogy between the planetary system and the molecular microcosm is perhaps equally applicable to the difficulties of study of these two extremes.

General chemistry and especially analytical chemistry have rendered inestimable services to society far exceeding any anticipations formed when these sciences were still in their infancy. For some years the study of solutions, thanks to Arrhenius' theory of electrolytic dissociation of molecules, has given rise to a new branch of chemistry which consists in measuring the H-ion concentration of these solutions. This new branch of science has undergone great extensions in Germany, Denmark and especially in America.

In the New World, where practical realisation of discoveries and inventions is effected much more quickly than elsewhere, the determination of Hydrogen ion concentration constitutes a very convenient and very precise means either for preparing media of microbe culture, or for controlling or estimating various industrial solutions.

Hydrionometry can also give valuable indications to agriculture. An account will here be given of the result of research, the agrochemical deductions drawn from them, and of a new hydrionometric method.

A number of works exist in English on this subject, but there is little in French, either original or translated. Leaving the literature aside, some considerations of a theoretical and technical kind may be reviewed.

A. — Theoretical considerations.

According to Arrhenius' theory, salts in aqueous solution are more or less completely dissociated into ions. Acids are salts of hydrogen and bases are salts of hydroxyl.

A solution of a weak acid HA, contains "active" H and A ions, and "potential" ions contained in the non-dissociated mass H A. The state of equilibrium between H and A on one side and H A on the other is expressed by the equation

$$\frac{(H^+)\ (A^-)}{(H\ A)} = Ka \qquad (1)$$

where Ka is the constant of dissociation and indicates the strength of an acid; (H^+), (A^-), (HA) indicate simply the concentrations of the ions H, A, and of H A during equilibrium. If this acid is titrated by a base, the equilibrium is constantly broken and re-established, until the H ions are completely exhausted as shown by the indicator. While acidimetry has the object of measuring the "normality", that is to say the total amount of the "active" and "potential" H of an acid, hydrionometry on the other hand only measures the "intensity" of an acid, that is to say the "active" H ions of the solution. Hence we must distinguish between the factor of "quantity" of an acid and that of the "intensity" of the same acid.

Every solution, whether acid, neutral or alkaline, contains H and O H ions; the reaction is neutral if $(H^+) = 10^{-7}$ at 22° C. in gramme ions per litre, acid if $(H^+) > 10^{-7}$ at 22° C. in gramme ions per litre, alkaline if $(H^+) < 10^{-7}$ at 22° C. in ions gramme per litre.

Water though very slightly dissociated contains about one gramme molecule of H and O H ions per ten million litres.

In pure water $(H^+) = (O\,H^-)$ which enables us to write

$$\frac{(H^+)^2}{(H\,.\,OH)} = Ke \qquad (2)$$

$(H\,.\,O\,H)$ being practically constant,

$$(H^+)^2 = Ke.\,(H\,.\,OH) = K_w, \text{ and}$$
$$(H^+) = \sqrt{K_w} = 1.006 \times 10^{-7} \text{ or } 10^{-7}$$

whence $K_w = 10^{-14} = (H^+)\,.\,(OH^-)$.

If in a base $(OH^-) = \frac{N}{100}$ that is to say 10^{-2}, (H^+) will equal:

$$(H^+) = \frac{10^{-14}}{10^{-2}} = 10^{-12}\,N.$$

Chemists seldom exceed dilutions $\frac{N}{100}$ of acids or bases, every interval included between 10^{-2} and 10^{-12} escapes acidimetry and alkalimetry.

In practice (H^+) is expressed as a function of

$$\log \frac{1}{H^+} = \log \frac{1}{Ka} + \log \frac{\alpha}{1-\alpha} = pH,$$

a formula derived by the algebraic development of equation (1) and where α indicates the percentage of dissociation of (H A). The notation pH was introduced by SORENSEN and represents the common logarithm $\frac{1}{(H^+)}$.

pH varies inversely with the H ion concentration.

(H^+)	pH
10^{-0}	0
10^{-1}	1
10^{-2}	2
= =	=
= =	=
10^{-13}	13
10^{-14}	14

The buffer action. — This is the resistance offered by a solution to change of its pH by addition or loss of an acid or a base. This resistance varies with the solution as well as with the base or acid added to it.

Determination of pH. — Two principal methods are distinguished, namely, the electrometric method and the colorimetric method. The former gives accurate results, but it is more difficult to effect.

The colorimetric method, slightly less exact than the former (maximum error pH 0.2), can however fully satisfy ordinary requirements, that is, of course, if the necessary precision is observed. It is based on the fact that each indicator has its own zone of change comprised between pH 0 and pH 14. This zone of change, relatively narrow, is characteristic for each indicator. Thus phenolphthalein changes at p H 8.3 and gives a salt completely dissociated at pH 10.0, owing to its neutralisation. The zone of change of this weak acid (phenolphthalein) is therefore comprised between 8.3 and 10.0.

An indicator is a weak acid or base and consequently feebly ionised. Its neutralisation gives rise to a neutral salt which is then strongly dissociated and radiates two kinds of light: that which results from absorption is coloured and comes from the interior of the solution, the other, on the contrary, is reflected by the surface of the solution and is generally white light (Ostwald). The shades of a colorimetric scale are due to relatively small differences in the wave lengths of the reflected light.

Measurement by titration only makes use of the extreme colours of the zone, while hydrionometry, by means of type solutions whose pH is previously determined, fixes and utilises the intermediate stages.

B. — Technical considerations.

Type solutions. — The greatest precautions must be taken in their preparation. This is how Clark and Lub's type solutions should be prepared :—

Phthalate $\frac{M}{5}$. Dry at 115° C. $KHC_8H_4O_4$ $\frac{M}{5}$. 40.836 gr. per l.

KCl $\frac{M}{5}$. Recrystallise 3 or 4 times and dry the crystals for two days at 120° C.

$KH_2PO_4 \frac{M}{5}$. Recrystallise at least 3 times in distilled water and dry at 115° C. to constant weight.

$H_3BO_3 \frac{M}{5}$. Recrystallise several times in distilled water and dry in a dessicator with $CaCl_2$.

$Na\,OH \frac{M}{5}$. Boil distilled water in an Erlenmeyer vessel to drive off the CO_2, cool, add sufficient ethylic ether to form a layer 4 or 5 cm. thick and throw in carefully some metallic Na cut up into small pieces. The Na O H which is formed at the expense of traces of water contained in the ether, passes slowly through the layer of ether and is thus kept from carbonisation. Siphon and dilute quickly to $\frac{M}{5}$.

$HCl \frac{M}{5}$. Distill HCl to 20 % and dilute the distillate to $\frac{M}{5}$.

The tables below show how by mixing these solutions it is possible to obtain a whole series of standards.

$$\frac{M}{5}\ KHC_8H_4O_4 + \frac{M}{5}\ NaOH \text{ (at 20° C.)}$$

pH = 4.0	50	c.c. $\frac{M}{5}$	$KHC_8H_4O_4$ +	0.40	cc. $\frac{M}{5}$	NaOH —	Dilute to	200 c.c.
4.2	»	»	»	3.70	»	»	»	»
4.4	»	»	»	5.70	»	»	»	»
4.6	»	»	»	12.15	»	»	»	»
4.8	»	»	»	17.20	»	»	»	»
5.0	»	»	»	23.85	»	»	»	»
5.2	»	»	»	29.95	»	»	»	»
5.4	»	»	»	35.45	»	»	»	»
5.6	»	»	»	39.85	»	»	»	»
5.8	»	»	»	43.00	»	»	»	»
6.0	»	»	»	45.45	»	»	»	»
6.2	»	»	»	47.00	»	»	»	»

$KH_2PO_4 + NaOH$

pH = 5.8	50 c.c.	$\frac{M}{5}$	KH_2PO_4 +	3.72	c.c.	$\frac{M}{5}$ NaO H	Dilute to	200 c.c.
6.0	»	»	»	5.70	»	»	»	»
6.2	»	»	»	8.60	»	»	»	»
6.4	»	»	»	12.60	»	»	»	»
6.6	»	»	»	17.80	»	»	»	»
6.8	»	»	»	23.65	»	»	»	»
7.0	»	»	»	29.63	»	»	»	»
7.2	»	»	»	35.00	»	»	»	»
7.4	»	»	»	39.50	»	»	»	»
7.6	»	»	»	42.80	»	»	»	»
7.8	»	»	»	45.20	»	»	»	»
8.0	»	»	»	46.80	»	»	»	»

$H_3BO_3 + HCl + NaOH$

pH = 7.8	50 c.c.	$\frac{M}{5}$ H_3BO_3	$\frac{M}{5}$ KCl	2.61	c.c.	$\frac{M}{5}$ NaOH —	Dilute to	200 c.c.
8.0	»	»	»	3.97	»	»	»	»
8.2	»	»	»	5.90	»	»	»	»
8.4	»	»	»	8.50	»	»	»	»
8.6	»	»	»	12.00	»	»	»	»
8.8	»	»	»	16.30	»	»	»	»
9.0	»	»	»	21.30	»	»	»	»
9.2	»	»	»	26.70	»	»	»	»
9.4	»	»	»	32.00	»	»	»	»
9.6	»	»	»	36.85	»	»	»	»
9.8	»	»	»	40.90	»	»	»	»
10.0	»	»	»	43.90	»	»	»	»

Clark and Lub's indicators.

Zones of change		Concentrations
3.4 – 4.6	Bromphenol blue	0.04 %
4.4 – 6.0	Methyl red	0.02 %
6.0 – 7.6	Bromothymol blue	0.04 %
6.4 – 7.0	Bromocresol purple	0.04 %
6.6 – 8.2	Phenol red	0.04 %
7.2 – 8.8	Cresol red	0.04 %
8.2 – 9.8	Thymol blue	0.04 %

Test tubes. — In order that the results may be as precise as possible, tubes of white glass should be used of uniform thickness and diameter, otherwise there is risk of comparing the solutions under conditions of varying thickness which would be a cause of error. With this object we have instituted a practical and precise " solenometrical " (1) process. The apparatus required consists of a

(1) From the Greek solene = tube.

graduated test tube of 100 c.c. and a drop measure. The test tube is filled to 80 c.c. and the tube to be examined is plunged into it so that the bottom of the tube is level with the 50 mark of the test tube.

The level of the water then reaches a certain height above the 90 mark. The tube withdrawn takes away a little water which is restored by means of the drop measure.

Out of 300 tubes tested about 30 caused the water to rise to the 95 mark and 20 to the 94 mark.

It is evident how much the tubes differ one from another. The test tube to contain the earth filtrate should be of the same capacity as the scale tubes.

Filtration. — The theoretical and practical details will be found in all books on analytical chemistry.

The filtration of clay soils is not always very easy. The fine particles of colloidal clay easily pass through ordinary filter paper. Filtration on a double filter or by decanting only aggravates this difficulty. We have always obtained very clear filtrates by rapid agitation of 10 gr. of soil with 50 c.c. of distilled water, then pouring the whole quickly, but adroitly, on to a folded filter paper.

In this way the pores of the paper rapidly contract. The particles which are deposited on the filter paper itself also play an appreciable part in clarifying the filtrate. The first filtrates will be turbid, and should be collected in a vessel specially prepared. A dozen filtrations can thus be accomplished in 20 minutes.

C. — Results.

1. *Action of manures on the pH of the soil.* — For this research thoroughly prepared ground has been available: the experimental plots of Prof. Journée of the Gembloux Agricultural Institute. We took a first sample from them during very cold weather, a factor unfavourable to bacterial activity. Although these plots are of the same geological formation and are subject to the same surrounding influence, the different distribution of manures in the various plots has resulted in a special ionic character for each plot where for more than 10 years the same kind of manure and the same doses have been applied for the production of the same crop.

TABLE I. — *Species grown*: — *Kidney bean.*

Plots		pH
1.	Without manuring	7.45
2.	With 100 k. Na NO_3; 500 k. Superphosphate	7.00
3.	With 100 k. $NaNO_3$; 300 k. K_2SO_4	7.30
4.	With 500 k. Superphosphate; 500 k. K_2SO_4	7.20
5.	With 100 k. $NaNO_3$; 500 k. Superphosphate; 300 k. K_2SO_4	7.15

2. *Effect of aërobic micro-organisms on the pH of the soil.* — As might be expected the influence of manures on the (H^+) of the soil is therefore certain. Will it not also modify the bacterial condition? Biogenic factors are necessary to the higher plants in the same manner as to bacteria, and it is known experimentally at the present time that manures have an influence on these lower organisms. We shall see that the latter in turn influence the pH.

The same samples of soil subjected to a temperature of 26° C. for 48 hours, with a constant relative humidity, altered pH in very sensible proportion.

TABLE II.

Plots	Initial pH	Final pH	Difference	Yield per *are*
1. Complete manuring	7.15	6.60	0.55	25.833 Kgs
2. Without nitrogen	7.20	6,50	0.70	30.833 »
3. Without P_2O_5	7.30	6.90	0.40	24.166 »
4. Without K_2O	7.00	6.90	0.10	15.833 »
5. Without manure	7.45	7.10	0.35	23.333 »

(The species grown was the Kidney bean. The last column shows the yields per *are* of the ligneous matter of the Kidney bean).

What is most striking is the parallelism of variation of the yields and that of pH, the numerical importance of which for each plot measures the bacterial activity of the latter. The yield of a soil therefore depends on its richness in aërobic micro-organisms.

The soil is not merely a mixture of humus and mineral substances, but also pre-eminently a living medium.

The relative acidification of all the plots should also be noted, due, no doubt, to respiratory loss by the aërobic micro-organisms.

* * *

The taking of another sample on a very sunny warm day has given the following results :—

TABLE III.

Kidney bean.

Plots	Initial pH	Final pH	Yield per *are*
1. Complete manuring	6.6	6.50	25.833 Kgs
2. Without nitrogen	6.5	6.25	30.833 »
3. Without P_2O_5	6.8	6.80	24.166 »
4. Without K_2O	7.0	6.90	15.833 »
5. Without manure	7.1	6.60	23.333 »

TABLE IV.

Potatoes.

1.	Complete manuring		6.6 (Initial pH)
2.	Without nitrogen	500 k. Superphosphate 300 k. K_2SO_4	6.5
3.	Without P_2O_5	400 k. $NaNO_3$ 300 k. K_2SO_4	6.8
4.	Without K_2O	400 k. $NaNO_3$ 500 k. Superphosphate	6.9
5.	Without manure		7.25

Here the influence of solar heat on the pH of the soil by the agency of micro-organisms is manifest, giving results practically identical with those which have been obtained with artificial heating in the course of our experiments, an identity which shows the practical importance of the laboratory work done.

The figures of final pH in Table III were obtained after incubation of 60 hours under a temperature of 32° C. The new variations are smaller, but in the same sense as those of Table II.

The relative smallness of these variations is due to the difference of temperature on the days on which the samples were taken.

The acidifying action of the aërobic organisms is again confirmed.

The plot without nitrogen was most acidified, which agrees with PLUMMER's results. (The $NaNO_3$ indirectly basifies the soil by the Na_2CO_3 generated. Since the $NaNO_3$ is the only basifying manure, except lime, it is fully intelligible that its favourable effect should be so manifest on the crops).

3. *Effect of anaërobic micro-organisms on the pH of the soil.* — If badly aërated and water-logged soils are especially rich in strictly anaërobic micro-organisms, this should not be the case with healthy, well aërated soils where the anaërobic flora should property consist mainly of potential anaërobes, and to a secondary extent, of anaërobes in the strict sense. Apart from this hypothesis which is the logical one we should find a difficulty in interpreting the figures obtained which are grouped in the following table.

TABLE V.

Plots	Initial pH	Final pH	Difference	Yield per *are*	
Complete manuring	6.55	6.85	0.30	25.833	Kgs
Without nitrogen	6.50	6.70	0.20	30.833	»
Without P_2O_5	6.60	6.95	0.35	24.166	»
Without K_2O	6.70	7.10	0.40	15.833	»
Without manure	6.80	7.05	0.25	23.333	»

While badly aërated soils have a distinctly acid reaction, sound soils the aëration of which has been completely destroyed for 48 hours under a temperature of 23°C. show a perceptible decrease of their acidity or even have become alkaline.

The reaction of the soil is therefore subjected to the action in opposite directions of two forces of micro-organic origin. If one of these two forces happens to be entirely lacking, the action of the other will in the course of time markedly change the reaction of the soil so as to hinder all normal vital development. In sound soils, owing to the antagonistic action of these two forces, the reaction oscillates to left and right like the point of the hand of a self registering barometer.

4. *Relation between the two categories of micro-organisms and the yields.* — Two methods are in use for evaluating a soil from an agricultural point of view :— chemical analysis and physiological analysis.

The former is a rapid method, but by itself only gives very slight indications, while the latter is more efficient, but only gives results after the lapse of much time.

Our investigations enable us to discover a new process which we will call " biological ". The following comparative table brings out our starting point.

TABLE VI.

Plots —	Yields per *are* —	Aërobic bacterial activity (Table II) —	Anaërobic bacterial activity (Table V) —
2. No nitrogen	30.833 Kgs.	0.70	0.20
1. Complete manuring	25.833 »	0.55	0.30
3. No P_2O_5	24.166 »	0.40	0.35
5. No manure	23.333 »	0.35	0.25
4. No K_2O	15.833 »	0.10	0.40

It is seen that in normal conditions the yields are proportional to the richness in the aërobic bacteria of the soil, and inversely proportional to the richness in anaërobic bacteria, and in a more general way :—

The fertility of a soil is directly proportional to its aërobic bacterial activity and inversely proportional to its anaërobic bacterial activity. This is readily admitted if it is realised that a soil must become enriched in anaërobic bacteria according as it loses its physical properties favourable to plants (good aëration due to a lumpy character of soil, for example). The investigation of several categories of soils (clay, sand, sandy-clay, humus, etc.) of different qualities makes it possible to draw up tables which will give directly the degree of fertility of the soil examined.

D. — STAGONOMETRY : — NEW PROCESS FOR DETERMINING pH.

The utility of the extension of hydrionometric research has led us to seek for a less cumbrous method at least as precise as the ordinary colorimetric method which required considerable preparation and apparatus and in which moreover the shades of the scale become paler under the action of light, leading to errors.

When 1 cub. centimetre filtrate is treated with an appropriate

indicator, a change in colouring results of which the degree of transformation measures the H ion concentration.

This degree of transformation is rapidly determined by adding drop by drop an " alkaline reagent " to 1 cubic centimetre of type solution of known pH. The number of drops added to get the same coloration as the soil filtrate, to which an equal quantity of the indicator has been added, measures the (H^+) of the soil solution, concentration being read on the curve which corresponds to the indicator used. The " alkaline reagent " and the known pH are prepared commencing with CLARK and LUBS' stock solutions. The indicators are thus the same, but diluted to 0.01 %, which enables 1 drop of the indicator to be added for 5 drops of " alkaline reagent ", 20 drops of the drop measure used equalling 1 cc. of the alkaline reagent.

The "alkaline reagent " is composed of :—

$$50 \text{ c}^3 \text{ of } KCl \frac{M}{5}$$

$$50 \text{ c}^3 \text{ of } H_3BO_3 \frac{M}{5}$$

$$43.9 \text{ c}^3 \text{ of } NaOH \frac{M}{5}.$$

The solution of known pH is the CLARK and LUBS' type solution pH 5.8, no soils treated by us having given a stronger acidity than pH 6.2. The vessels in which the colorimetric (or stagonometric) (1) tests are made, consist of at least two small pure white porcelain basins. The covers of small crucibles upside down are very suitable for the purpose.

Into the first is put one cubic centimetre of very clear soil filtrate and 4 drops of the appropriate indicator. Into the second, in its turn, 1 c.c. of the solution of pH 5.8, 4 drops of the same indicator, and drop by drop " alkaline reagent " until perfect identity of coloration is reached.

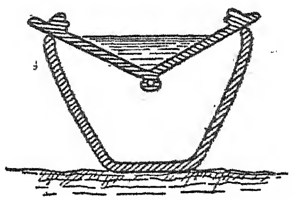

FIG. 41. — Vessel for stagonometric tests.

Note that one additional drop of the same indicator per 5 drops of " alkaline reagent " is required to maintain approximately con-

(1) From the Greek stagon = drop.

stant the relation between the quantity of indicator added and the volume of the liquid affected.

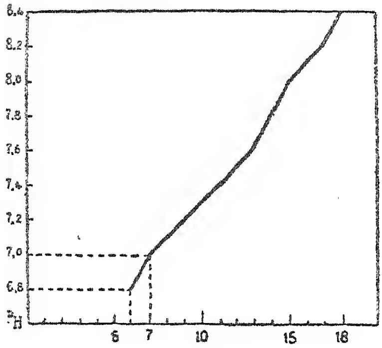

FIG. 42.
Phenol Red (6.8 to 8.6) Curve

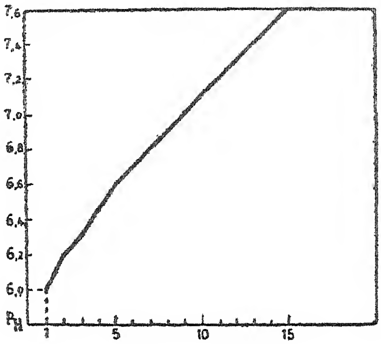

FIG. 43.
Bromothymol Blue (6. to 7.6) Curve

A curve can be drawn for each indicator. The method can be adapted to cover the whole pH scale.

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GRAPHIC REPRESENTATION OF THE KOPECKY SOIL CLASSIFICATION SCHEME FOR TECHNICAL PURPOSES.

Ing. J. SPIRHANZL published in the January number, 1925, of this Review a "graphic aid" to the KOPECKY soil classification scale. The same reasons which caused Ing. SPIRHANZL to reduce the KOPECKY scales to a more synoptical form led me to find the following method (exhibited at the Exhibition of the Fourth International Soil Science Congress at Rome).

The form of the circle was chosen partly on account of easier survey, but also in order to be able at the same time to inscribe a "drain distance curve".

For it is in the first instance the question of the distance between the drains which the agricultural engineer wishes to have answered.

We have not yet any scientifically based law on the interdependence of drain distance and drain depth. We only know that water drains less easily through heavy soil than through more permeable soil, and it follows from this that in the latter case a greater distance apart is permissible than in the former.

As regards the choice of the distance apart of the drains the expert was dependent on his experience.

It is a great service on the part of KOPECKY to have brought his "experience" in regard to drain-distance into mathematical correlation with the mechanical composition of the soil. The expert is thus enabled to determine the drain-distance on the available basis of the composition of the soil. FAUSER and GANS have calculated the results of KOPECKY for the climatic conditions of Würtemberg. But in these data of FAUSER there were principles derived from experience. By experiment KRÜGER gave to these principles a scientific basis, which confirmed the accuracy of KOPECKY's observations. (KRUGER, Int. Mitt. f. Bodenkunde, Vol. XI, pp. 105-110, Berlin, 1921).

I have now brought the soil classification scheme of KOPECKY to a system of sectors of a circle. The circumference of the circle is divided into 80 parts, for the percentage content of fraction I (diameter less than 0.01 mm). On the radius the proportion of fraction II is drawn to contents of 40 %. The sectors so formed represent the types of soil.

KOPECKY's, experience for our climate, according to the composition of the soil, with a drain depth of 1.30 m., distances of 8-24 m. have proved correct.

The direct reading, which corresponds to the distance suitable to the mechanical composition of the soil determined by analysis, can be taken from the graph without compasses or any other aid, direct on the inscribed " drain distance curve ".

It is of course natural that the measurement of the distance, based on the mechanical composition of the soil, may undergo certain alterations due to local circumstances (sloping land, lime and iron contents). But the basis of the determination of the drain distance can here be formed in accordance with mathematical view points, and estimation, with its subjective errors, is avoided. This determination is only valid, of course, on the hypothesis, which indeed can seldom occur, that the soil is of uniform quality to a depth of 1.3 m. throughout.

In general we shall have to deal with different layers of soil. Each of these layers would, however, require a different drain distance. Dr. BLAUTH, Lemberg (comp. FRIEDRICH, Wasserbau, Vol. I, p. 340) gives a graphic method of determining the correct distance with layers of different permeability. The process corresponds approximately to the penetration of a ray through different media, it being sumed that " ideal water " moves in a similar manner in the ground.

The results obtained, in any case, agree pretty well with experience with regard to the correctly measured dike distance, so that this method can be considered as practicable.

With my curves, with only two different layers, the corresponding distance can be read off, without any measuring or drawing (such as BLAUTH gives).

For instance, the upper layer is sand (50 cm.) ; the corresponding dike distance for sand would be 20 m. ; the lower layer is clay (80 cm.); the corresponding dike distance 8 m.

The determination now takes place in the following manner : we only require to look for the intersecting point of the curve with a connecting ray which indicates the corresponding thickness of a layer : e. g. 50 cm. sand, or 80 cm. of clay. The perpendicular on the abscissa axis gives direct the corresponding drain distance ; in the above example 12.70 m., therefore 13 m. The same applies with other layers combinations.

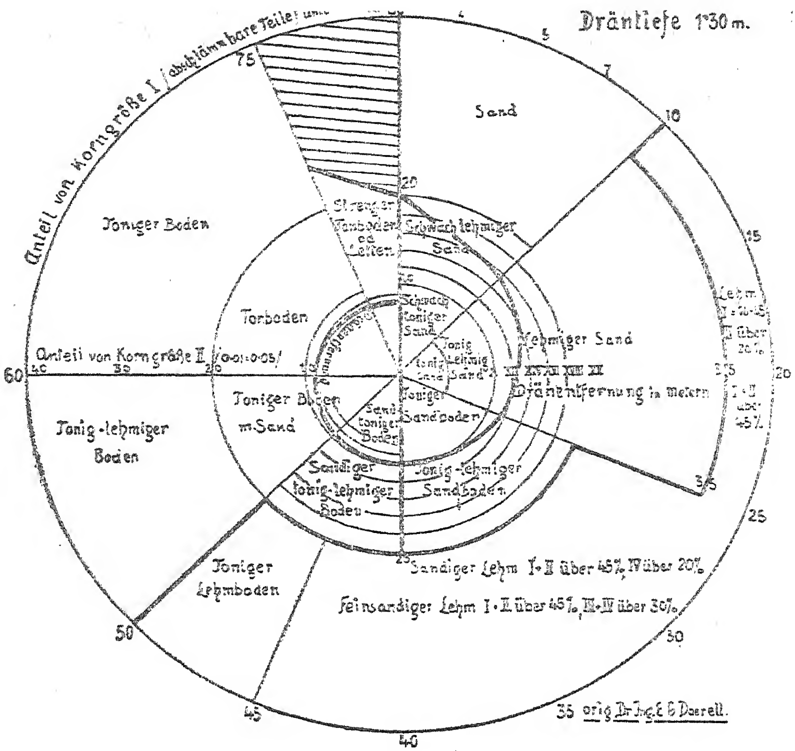

FIG. 44. — Representations of the KOPECKY Soil Classification Scheme, with 'drain distance curve'.

Explanation of the diagram.

Dräntiefe 1,30 m.	Drainage depth 1.30 m.
Anteil von Korngrösse I (Abschlämmbare Teile). unter 0.01 mm.	Proportion of particles of Type I (part capable of decantation) of diameter less than 0.01 mm.
Sand	Sand.
Lehm	Loam.
I = 10 — 45	Type I = 10-45.
II über 20 %	Type II over 20 %.
I + II über 45 %	I + II over 45 %.
Sandiger Lehm I + II über 45 % : IV über 20 %	Sandy loam I + II over 45 % : IV over 20 %
Feinsandiger Lehm I + II über 45 % III + IV über 30 %.	Fine sandy Loam I + II over 45 % : III + IV over 30 %.
Toniger Lehmboden	Clayey Loam soil.
Tonig-lehmiger Boden	Clay loamy soil.
Anteil von Korngrösse II (0.01-0.05 mm.)	Proportion of particles of Type II (diameter of from 0.01-0.05 mm.)
Toniger Boden	Clayey Soil.
Strenger Tonboden od. Letten	Heavy Clay Soil.
Schwachlehmiger Sand	Sand slightly loamy.
Lehmiger Sand	Loamy sand.
Dränenentfernung in Metern	Drain distance in metres.
Tonig lehmiger Sandboden	Clay loamy sandy soil.
Sandiger tonig-lehmiger Boden	Sandy clay loamy soil.
Toniger Boden mit Sand	Clayey soil with sand.
Tonboden	Clay soil.
Schwachtoniger Sand	Slightly clayey sand.
Tonig lehmiger Sand	Clay-loamy sand.
Toniger Sandboden	Clayey sandy soil.
Sandtoniger Boden	Sandy clay soil.

In case we have to deal with several different layers, we first proceed to determine graphically (after BLAUTH) the drain distance of the two lower layers, and then simply apply the ascertained value in the sense of the above explanation, as though we had to deal with a uniformly composed layer.

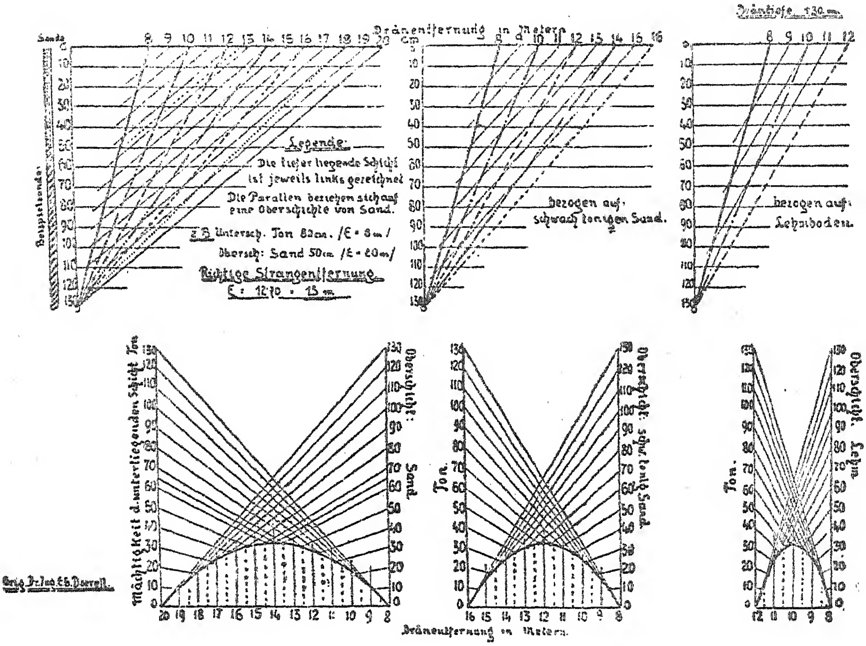

FIG. 45. — Diagram (or graphs) for the determination of the drain distance in layers of soil with varying permeability.

Explanation of the text.

Dräntiefe	Drainage depth.
Dränentfernung	Drain distance.
Sonde	sounding or probing.
Beispielsonde	sample probing.
Die tiefer liegende Schicht ist jeweils links gezeichnet.	the lower layer is always shown on the left.
Die Parallelen beziehen sich auf eine Oberschichte von Sand	The parallels refer to an upper layer of sand.
Z. B. Untersch. Ton 80 cm. (E = 8 m.)	e. g. Lower layer clay 80 cm. drain distance 8 m.
Obersch. Sand 50 cm. (E = 20 m.)	Upper layer sand 50 cm. drain distance 20 m.
Richtige Strangentfernung E = 12.70 — 13 m.	Perpendicular distance E = 12.70 i. e. 13 m.
bezogen auf schwachtonigen Sand	Referring to slightly clayey sand.
bezogen auf Lehmboden	Referring to loamy soil.
Mächtigkeit d. unterliegenden Schicht Ton	Thickness of clay substratum.
Oberschicht Sand Ton	Upper stratum of sand.
Oberschicht schwachtoniger Sand	Upper stratum of slightly clayey sand.
Oberschicht Lehm.	Upper stratum loam.

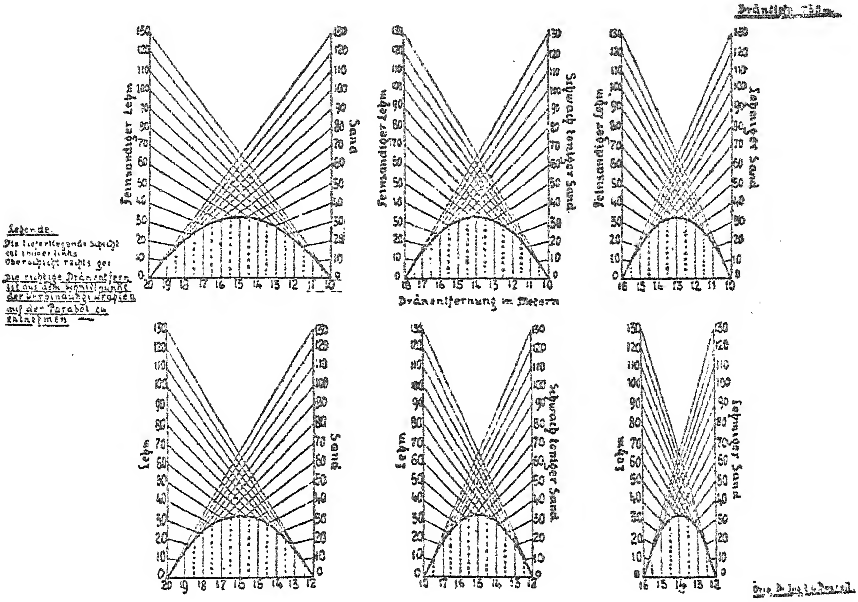

FIG. 46. — Diagrams for the determination of the drain distances in layers of soils of varying permeability.

Explanation.

Feinsandiger Lehm	Fine sandy loam.
Sand	Sand.
Schwachtoniger Sand	Slightly clayey sand.
Lehmiger Sand	Loamy sand.
Lehm	Loam.
Dränentfernung in Metern	Drain distances in metres.
Die tieferliegende Schicht ist immer links, die Oberschicht rechts gez.	The deeper layer is always shown on the left, the upper stratum to the right.
Die richtige Dränentfernung ist aus dem Schnittpunkt der Verbindungstrahlen auf der Parabel zu entnehmen.	The right distance between the drains is to be inferred from the point of intersection of the connecting rays on the parabola.

Of course, there might still be mentioned the very difficult point whether, in such cases where layers occur which are permeable with difficulty, to a small depth e. g. clay or loam, we could maintain a drain depth of 1.30 m. In general, the tendency to-day, in such cases, is to reduce the drain depth.

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INVESTIGATIONS INTO THE RESISTANCE OF SANDY SOILS TO WETTING.

The water conduction of a soil is influenced in a high degree by the ease of wetting of the soil particles. Even though in general no great differences are to be observed in the susceptibility of the soils to moisture, yet it can often be noticed, especially with loosely laid dusty soils, that after long drainage they only absorb water with difficulty. This fact, however, is in no way confined to dusty soils (amongst these, in this sense, must also be counted powdery peat, "dust mould" and road dust) (1). Even on light-mould sandy soils, as RAMANN (2) has already mentioned, collections of water can occasionally be found in small depressions many hours after rain, whilst the sand lying underneath is still powder dry. Recently BUNGERT (3) has thoroughly observed and described this fact.

As to the reasons for this "resistance to wetting" (4) of the soil, various theories have been advanced. Originally it was assumed that the non-susceptibility to moisture of drained peat or mould particles was caused by a coating of resinous or wax-like matter (5), and RAMANN (6) also traces back the high moisture-resistance to the like substances. "Once drained, these impervious substances coat the soil particles, and offer strong resistance to their saturation". This assumption is controverted on other sides, especially by EHRENBERG (7), in conjunction with PUCHNER (8) and FLEISCHER (9).

These authors assign, as a reason for the difficulty of absorbing moisture by dry soil particles, in particular dried humous material, that these have a great capacity for absorbing air, a less capacity for absorbing water or moisture, and are protected from the moisture by this absorbed air covering (10). As a further factor, these investigators adduce the fact that the air in the capillary spaces of the soil prevents the penetration of water. One of the authors has already shown that in addition to all these factors there are still others, for example the condition of the organic matter to be taken into account in judging the ease for absorbing moisture (11). "Soils with preponderance of acid humus become moist even when only air dried, with disproportionately greater difficulty, and slowness than so called sweet humus soils with an equal percentage of organic matter".

On the occasion of other investigations our attention was drawn

to a soil with extraordinarily poor moisture-absorbing capacity, and its resistance to wetting could not be explained in any of the above ways. It was a fairly coarse diluvial sand with little humus from the Chorin high forest, on which acacias did not thrive. The sand, under a very thin layer of humus after long rainfall, and the thawing away of a fall of snow about 5 cm. deep, contained only 0.63 % of water. Placed in water, its moisture resistance showed itself in the fact that after 24 hours th ewater could be poured off from the unaltered dry soil. A superficial film of water clinging to the sand broke up on being touched. The difficult absorption of water was still more clearly recognisable by the fact that a considerable part of the sand remained floating on the surface of the water, and could be made to sink neither by shaking nor by stirring. These floating portions, however, were in no way composed of the finest fractions of the soil, nor of organic constituent parts. Observation under the microscope showed that grains of quartz predominated, mixed with small grains of felspar or the like, and very small particles of mould. There were also throughout grains of considerable size. A few samples, which had remained floating for about 250 hours, were measured on an oaken ocular micrometer. Out of about 350 grains :

61 grains, about	17 %,	had a diameter of about 0.02	mm.
35	10 %	0.05-0.08	mm.
117	32 %	0.1	mm.
89	25 %	0.2	mm.
37	10 %	0.3	mm.
14	4 %	0.4	mm.
5	2 %	0.5	mm.
2	0.6 %	0.6	mm.

1 large grain, length about 1.6 mm., width about 0.6 mm.

The measurements must in no way be claimed as being of special exactitude as regards the actual sizes of the grains of sand, or as an exact selection of average samples. They show, however, plainly enough that about 55 % of the floating grains have the considerable size of 0.1 to 0.2 mm., that a large proportion are still larger whilst particles below 0.02 mm. diam. are practically absent.

Similar estimates were applied to a whole series of other samples.

It is obvious that the moisture resistance of grains of this size cannot be due to absorbed air coverings, which in the case of the finest dust no doubt play a part (12), nor to the air retained in the capillary spaces, nor to any coating of resinous or wax-like substances (13). Acid humus, difficult to wet, probably does no enter into the question. The humus content of the sands determined as loss on ignition amounted to 1,17 % and the acidity of the soil was in no way high.

There was found :

Exchange-acidity according to DAIKUHARA : 4.8 ccm.n/10 NaOH to 100 gm. soil.

Hydrolytic acidity : 21.2 ccm. n/10 NaOH to 100 gm. soil.

We now tried, by increasing the vapour pressure, to make the soil capable of absorbing moisture. For this purpose a sample of air dried soil was kept for 36 hours over water in a vacuum dessicator. At the same time other samples were allowed to stand over different concentrations of sulphuric acid, so that an idea could be formed of the hygroscopicity of the sand. The determination of the water contents of the samples treated in this way gave the following values (14).

Contents of the dessiccator	H_2O	H_2SO_4 %									
		10	20	30	40	50	60	70	80	90	100
H_2O content of the soil in % ...	0.98	0.62	0.35	0.26	0.10	0.03	0.01	0	0	0	0

None of the samples showed any difference as regards their capacity for wetting.

On the contrary, moistening at once occurred when a few drops of ammoniac were added to the water.

Treatment of dry soil with gaseous ammonia had a similar result. Ammonia gas, obtained by heating a strong solution, was cooled in a spherical cooler directed downwards, the water condensed in a receiver previously dried being collected. The gas was further dried in a large drying tower having layers of carbonate of lime, and then conducted at a measured rate (about 3-4- bubbles per second) over the soil spread out in a wide glass pipe. After being conducted

over for half an hour the superfluous ammonia was removed by drawing through air for 20 minutes. After that the soil was at once susceptible to wetting. It did not lose this property after it had been exposed to the air for 24 hours in a thin layer.

The objection might be raised that it was originally the absorbed air films which protected the grains of sand from moisture, and that the action of the ammoniac caused the air films, as a result of a greater absorption power of the grains of sand for ammonia to be driven out and replaced by ammonia. The moistening would then be attributed to the very great solubility of the ammonia gas in water. This objection will, however, fall to the ground, as the soil also, became moistened in water containing a little Na_2CO_3. We tried however whether the moistening of the soil might not be attained by the action of other gases but the gases used by us, carbon dioxide and sulphur dioxide, in no way altered the moisture resistance of the soil, in spite of the great solubility, especially of the sulphur dioxide, in water.

We now followed the moistening process of the soil in water and in dilute ammonia under the microscope. Even though an exact picture could not be obtained, as with the necessarily considerable enlargement only a very small part of the surface of a grain could be closely observed, yet we received an impression as though the grains of sand were covered over by a thin, brownish skin, which quickly dissolve in dilute ammonia, and after that allowed the moistening of the grains concerned. It could consequently be deduced with reason that these skins were formed of humus substances. If this supposition was correct, then it should be possible to make the sand take up moisture by removing the humus coating. It seemed to us that heating (although the sand was thereby made saturable) and similar processes were too drastic, and we chose therefore the method, first proposed by ROBINSON (15) and recently recommended by HISSINK (16) for another purpose, for the destruction of the humus substances by means of hydrogen peroxide. It was shown that the soil became moistened after standing for several hours in 3 % H_2O_2, and in 30% H_2O_2 became moistened almost immediately. When the soil, after treatment with H_2O_2, was filtered, washed with water and dried, or stirred directly with H_2O_2 in the water bath and dried by evaporation it still remained easily saturable, whilst a sample treated with water only in like manner maintained its high resistance to wetting.

Another means of removing the humus coating is an acid solution of oxalate of ammonia, as used by O. TRAMM (17) for the removal of inorganic gel coverings of soil grains and also recommended by K. LUNDBLAD (18). As the investigations of TAMM (17) showed that the TAMM solution (31.52 gm. oxalic acid and 62.1 gm. neutral oxalate of ammonia to the litre of water) does not attack the mineral grains of the soil, it appeared to be specially suitable for this purpose. In fact the sand became moistened in a short time in the TAMM solution.

Another proof may be given that the above mentioned operation of the ammonia gas does not depend on the absorption of this gas by the grains of soil. A weighed sample of the sand dried at 105°, treated with ammonia in the manner mentioned and afterwards with air, was boiled with water, and the escaping ammonia was conducted into n/10 sulphuric acid. By titration with n/10, alkali the quantity of sulphuric acid neutralised by the ammoniac was fixed. It was shown that 100 gm. soil had absorbed 0.0204 gm. NH_3, whilst the soil after the destruction of the humus with peroxide of hydrogen, and after washing with water, only retained 0.004 gm. NH_3 (calculated on 100 gm. soil and determined in like manner). It is shown quite clearly, therefore, that the absorption of ammonia only takes place with the co-operation with the humus substances in notable extent, and that the sand free from humus is not favourable to this adsorption.

The question now remains how the influence of the *humus coating on the moisture capacity* of the soil is to be explained. The interpretation that the humus substance covering the sand grains has become irreversible by great drying, and thereby resists the moistening, appears to us not very probable, because if so, these light humus sands, difficult of saturation, would, in our opinion, be found much more frequently. The occasion for the formation of humus coverings, and the drying of these, must arise very often, whilst the high degree of moisture resistance here described is not so often observed. It is possible that the humus molecules, as (according to LANGMUIR (19) the large molecules on border surfaces often do) range themselves in regular formation on the surface of the sand grains in such a way that "lyophobe" groups of molecules are directed outwards. The relative infrequency of the difficult saturability might then, therefore, give the impression, either that not all kinds of humus contain lyophobe groups, or that the humification does not al-

ways result in the formation of lyophobe groups, or that the relationship of humus molecules only occasionally, or only under still unknown conditions, takes place in such a way that the lyophobe groups are turned outwards. It is up to now equally uncertain why the removal of the moisture-resistance is effected by ammonia. It might be that, as mentioned above as being improbable for sand grains, the ammonia is physically absorbed on the humus covering. These ammonia films would immediately dissolve in water, and cause the wetting of the soil particles. Consequently the humus films could then be detached and dissolved by the resulting local concentrated ammonia solutions. In fact, soil treated with NH_3, when covered with water, after some time acquires a brownish colour. That not physical adsorption alone comes into the question is proved by the fact that on boiling soil treated with NH_3 in water, only about half of the ammonia rendered removable by distillation with oxide of magnesia is recovered. There may therefore occur, at least as regards physical adsorption, a chemical reaction between ammonia and mould. If highly humus soils and pure sphagnum peat, all dried at 105° to a constant weight react with ammonia gas under great heat, as we could establish, then theoretically both processes, chemical reaction and physical adsorption may occur even though in our estimation the chemical reaction is more probable.

Unfortunately we must postpone our experiments with reference to the above matter until summer, on account of other pressing work, and above all, for lack of suitable material. Nevertheless it seems to us that our investigations up to now, which in every respect are only considered as preliminary experiments, show plainly that the vegetable humus coverings of the grains of soil play, at least in many cases, a decisive part in the saturability of the soil concerned. And this result appeared to us sufficiently interesting to warrant a preliminary communication.

The treatment of the soil with ammoniac in the form of gas also appears to us interesting in another direction. In this connection we have investigations in train as to whether the adsorption capacity of a soil for NH_3 can be applied to determine its humus contents, and whether eventually conclusions can be drawn from this on the nature or condition of the humus. We will report in due course on the results of these investigations.

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ANNOTATIONS AND BIBLIOGRAPHY.

(1) Compare, as to this, e. g. B. EHRENBERG: Die Bodenkolloide, 2. Ed. 1918, pp. 246, seq.

(2) RAMANN, Bodenkunde, 2. Ed. (1911), p. 345.

(3) DISS. Forstl. Hochschule Eberswalde 1925 ; Z. f. Forst- und Jagdwesen, Fasc. 11, p. 547 seq. (1925).

(4) RAMANN, *l. c.*, S. 344.

(5) Literature data EHRENBERG, *l. c.*, p. 248 et seq.

(6) *l. c.*, p. 345.

(7) *l. c.*, p. 259 et seq.

(8) H. PUCHNER, Forsch. Geb. Agrikulturphysik 19, 11 (1896).

(9) M. FLEISCHER, in VOGLER, Kulturtechnik, 2. Ed. (1898), Vol. 1, p. 119.

(10) Experimental proofs and literature see EHRENBERG, *l. c.*, p. 250 et seq.

(11) Albert, *Journal für Landwirtschaft*, 56, p. 370, 1908.

(12) See the experimental proofs in EHRENBERG, *l. c.*, p. 250 et seq.

(13) To determine whether absorbed air might not be the reason for this appearance, we made the following experiment: A sample of the sand, floatiug on water in a small dish placed in a desiccator, was exposed for several hours to a vacuum of about 12 mm. No moistening took place after 36 hours.

(14) All the analysis data are average values, each of two denominations.

(15) Jnl. of Agric. Science, XII, p. 287 et seq. (1922).

(16) Mitt. d. Intern. Bodenkundl. Ges., New Series, Vol. I, No. 3, p. 158 (1925).

(17) *Meddelanden fran statens skegsförs öksanstalt*, Fasc. 9, No. 4 (1922). Communications of the Swedish State Experimental Station for Forestry.

(18) *Ibid.*, Fasc. 21, 1924.

(19) Journ. Amer. Chem. Soc. 39, 1894-1906-1907) comp. ZSIGMONDY, Kolloidchemie, 5. Ed., pp. 109-114. Leipzig (1925).

ON THE LIMITS OF BIOLOGICAL INQUIRY IN SOIL SCIENCE.

"*Some unknown cause*" — it would seem — led GEORGES VILLE to the much challenged results of his celebrated experiments establishing the remarkable gain of nitrogen which takes place during the cultivation of leguminous plants.

The ancient world which lived — and unavoidably so — in ignorance of micro-organisms was nevertheless aware by intuition that something must intervene before the indirect elements of nutrition could enter into the structure of the plant organism; and while labouring under the disadvantage of the virtual impossibility, with the means then available, of following the metamorphosis of alimentary materials in agricultural soil, it arrived at the assertion of the existence of transformations such as had effects of manifestly fundamental importance.

The important subject of the fertilisation of the soil was really involved in the question.

This subject deeply engaged the minds of students; all kinds of paradoxical theories were indulged in by scientists; feeling ran high between manufacturers and dealers of manures.

Theories of all kinds found acceptance, deriving life from organic matter, from a vital principle, from humus, from nitrogen, from minerals.

While this *unknown cause* was for the "vitalists" who were the most advanced section of the "humists" a transcendental one, if for them it was not necessary to go much further than the *vital matter* of TREVIRANUS, for the true "humists" everything consisted, at most, in some physical and chemical actions, play of movements and attractions of masses or of elemental affinity.

Even the ideas diffused with great energy by LIEBIG and defended by him against those who maintained theories on organic substances and nitrogen were not free from errors, some of a serious and fundamental nature. The relinquishment of experimental work in favour of polemics conducted with liveliness, not to say acrimony, led LIEBIG to form that erroneous inference, which consisted in attributing to the organic substance of the soil and manures value only such and so far as mineral bodies resulted as the final product

of its destruction. Reasons of space do not allow of the quoting of certain very striking passages in the works of LIEBIG.

Between the premise that a successive series of crops impoverishes the soil and the conclusion that for a return *to the fixed point* nothing is necessary but the restitution to the soil of the elements of the plant ashes previously removed, we shall find that LIEBIG interposes this scientific contribution :— Ammonia and the combustible substances of manures have a stimulating effect ; fallowing and tillage are of value for cleaning the soil of weeds or for mechanical modifications of the soil ; organic substances have no power of producing abundant crops; the action of stable manure depends solely on the mineral elements contained in it. For that reason it must be useless, or even harmful, for fodder to pass through the digestive system of animals ; stable manure was not indispensable to plant production ; and, in short, everything would be reducible for plants to the preparation and administration of tabloids, just as has been prophesied for the nutrition of Man, who is to be, in the future, a non-material being. To form an idea of the phenomena of capital importance which develop in the soil and which these theories completely ignore, it suffices to go back to that biochemical cycle of phosphoric anhydride which is made evident by our researches and in which is involved the active power of almost all mineral salts useful to the plant (Fig. 15).

The action of phosphorus in the soil is accomplished in two opposite senses, namely it passes from monometallic phosphate, through bimetallic, trimetallic phosphate and viceversa. In the first case the action is physical and chemical, in the second case biochemical, both, one and the other, in a fixed correlation.

Along with the interplay of the acids and acid salts of phosphorus with the various bases of the soil, the micro-organisms cause an evolution in the organic substance of the soil, from which originate more or less complex *phosphorganic substances*, acid or containing acid radicals which easily become free, and they too contribute largely to the mobility of the potash, lime, magnesia, iron, etc.

Hence there are two cycles of the phosphorus in the soil :— the *mineral* and the *organic*. The extreme limits of the first are basic phosphate and acid phosphate. This once formed, and a certain proportion of bases attacked, unless some factor maintaining the biochemical conditions of its existence intervenes with the

occurrence of chemical and physical actions, it returns to the insoluble state.

In the organic cycle, on the other hand, this *retro-gradation* does not take place ; and the phosphorated substance, more or less salified, soluble or easily soluble by saponification of the large nuclei from

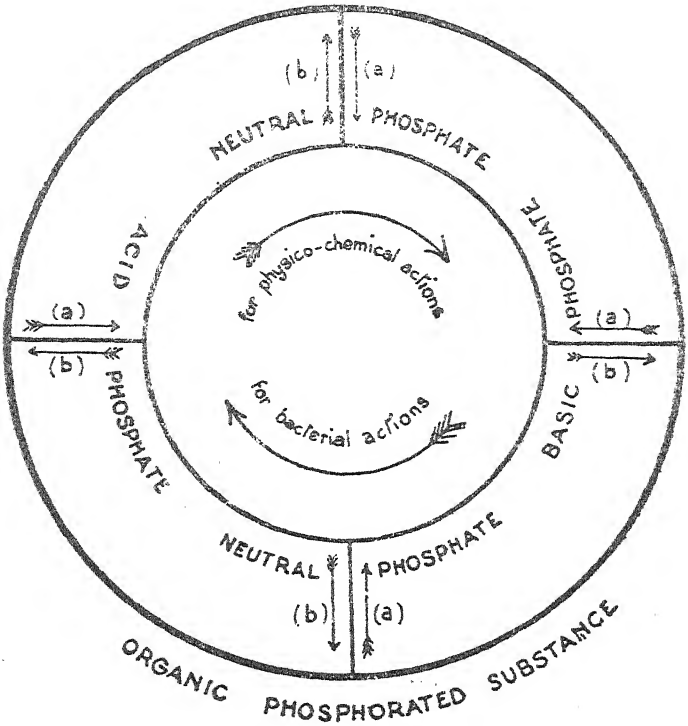

FIG. 47. — Cycle of phosphoric anhydride in the soil.

which it results, is to a great extent employed directly in the metabolism of new forms of life which succeed one another unceasingly in the soil.

Moreover, continuous relations of transformations exist both in one sense and the other between the two cycles by which one form of phosphorus can pass more or less indirectly into the other. And, on the one hand, forms of autotrophic life, and on the other those of heterotrophic life intervene. By the one, mineral phos-

phorus may at any moment pass from its circle into the organic; by the other, on the contrary, it may return to the mineral state. But since the organic combinations of phosphorus constitute a material productive of energy, they tend to effect biochemical transformations in the way of mineralisation which is agriculturally disadvantageous; however the opportune provision of dynamogenetic materials interferes with the play of bio-reactions and leads to useful results.

We are inclined to dispute the right of anyone to suppress, with or without LIEBIG, in the name of science and of the so-called results of practice, the fundamental function of organic matter in the economy of the medium in which plants live. Nor can we admit that any one should endeavour to specify the contribution of science to agriculture by a simple mathematical relation such as:

$$\begin{array}{ccccc} P & = & A & - & O \\ \text{production} & = & \text{available food} & - & \text{opposing factors} \end{array}$$

A biological phenomenon, one may say a complex series of biological phenomena relating to production, is not represented by any mathematical formula, either simple or complex. Besides it presupposes that *the environment in which plants live is something fixed, unchanging and that the vegetable kingdom is directly dependent on the mineral kingdom.*

The real truth is that agricultural soil is not an unchanging entity and that between minerals and cultivated plants there is interposed such a complex series of phenomena and factors dependent on the new realm of micro-organisms as to make Liebig's equation appear an irony.

Organic matter, considered as the stimulating force of the life which teems in vegetable soil and of its perpetual mutability, is evidently not the matter of TREVIRANUS and of other "humists" and still less is it that accessory or superfluous element which LIEBIG conceived it to be.

To organic matter we attribute in agricultural economy a preponderant and absorbing function in the unfolding of that micro-organic activity which cannot be wholly suppressed and in the well ordered and useful action of the material substratum, where these exchanges of matter and energy take place whence the higher plant draws the very possibility of its existence — namely the soil.

Our conclusion then is that the manifold forms of life may be

united under a single general conception of correlativity which corresponds to the rea *functional correlation* (*symbiosis*), as it exists and, is every day more fully proved to exist, in Nature.

* * *

The tendency for two or more elementary organisms to unite to form higher grades of individuality is clearly manifest in ontogenesis as in phylogenesis : between these organisms there exist relations of descendance. But where such relations are non-existent, there arises this new fact which originally formed the subject of morphological investigation by DE BARY and which is called *symbiosis*.

A new chapter of the biological sciences was thus begun, to which as time went on a development brilliant beyond expectation was assured by the progress of research : that, in general, of the relation between organisms which, governed by the need of food, lead to reciprocal exchanges of substance and therefore to more or less intimate relations, pacific or hostile.

The type of nutrition known as *saprophytic* will be dealt with here under *symbiotic nutrition*, which is interesting in itself apart from its characteristics, as it is a phenomenon of extraordinary importance in natural economy and, particularly, in the investigation of the soil.

A primary distinction which has been made as regards life in common is that of *mutualistic* life and *antagonistic* life, according as the exchange of matter takes place with reciprocal advantage, with one-sided advantage (commensalism), or with injury of one of the organisms.

Antagonistic symbiosis, which is *parasitism*, is here considered as throwing light upon the other form of symbiosis which is the true form and constitutes in nature the evolutionary fact while in soil science and agriculture it is a subject of study and a means of technical improvement.

Between antagonism and mutualism there is no precise boundary, and through all the transition states from the facultative to the obligatory, from variability to fixity, from one-sidedness that is of no consequence to that which is injurious, absolute reciprocity is ultimately attained, without excluding the phenomenon, perhaps more astonishing, of alternation between one and the other kinds of life.

It used to be thought that pathogenic power, within quantitative limits — varying between virulence on the one hand, and recep-

tivity on the other — was a characteristic property of certain species, but this theory is not now generally held, while the view is gaining ground that certain species, essentially saprophytic, are forms capable of developing a pathogenic power.

Indeed, the power of adaptation among microbes is very great and if this is easily established in the case of the antiseptics, it is presumed that it can be verified also against the antibacterial actions of the humours and cells of the host organism. With the alternation of the conditions of occurrence of activity of one or other organism may come alternation of the two regimes of life with opposite characters; and hence the mechanism of nutrition becomes extraordinarily instructive.

The contrasting play of actions and reactions between the two organisms only begins when the saprophyte becomes an *epiphyte*.

The phenomenon is also more interesting when the number of the individual epiphytes increases and they become *endophytes*.

Thus one passes to still more advanced stages of infection and to still closer relations of commensalistic and mutualistic symbiosis.

It is a very instructive fact that the attack of *Rhizoctonia* is essential for the germination of the greater number of the orchids, the influence even persisting on the later development causing more or less profound manifestations and morphological changes; but the examples of relations between vegetable organisms of different nature, phanerogams and cryptogams, especially fungi, are varied and numerous, a striking example being that of the *mycorhizae*. The phenomenon of the mycorhizae constitutes in fact one of the many cases of struggle between a given organism and a parasite which invades its tissues. Phagocytes on the one hand and anti-bodies on the other, it may be supposed that they would enter into play in the mechanism of nutrition of a large number of plants which, while they hold the invader in check, avail themselves either of the material constituting its body or of its functional character. And this under conditions of an unstable equilibrium, which, while normal and indefectible, is still the resultant of many conflicting forces, such as may on the one hand work for improvement but on the other have the power to bring about vital destruction.

* * *

But the physiological research on entomophytic fungi, begun about 1900, would lead, as regards the association of bacteria with

the higher plants, to an order of ideas diametrically opposite to that held in relation to the micro-organisms when they invade the organs of a plant.

The notion of *pathogenic agent* has been contrasted with the clear demonstration of the distinct tendency which organisms have to utilise the useful physiological work of symbiotic micro-organisms. This fact is demonstrated by the forms of *Isaria* and *Botrytis* in the larvae of wood-eating insects (PORTIER), by bacteria localised in the blind diverticoli of the middle intestine of the larva of the olive fly (PETRI), by the photogenic bacteria contained in special organs of many luminous deep-sea fish or other forms of life. (PIERANTONI), etc.

The conception of *physiological micro-organism* is thus formed and enters also into the study of symbiosis in plants, marking the beginning of a series of very interesting enquiries.

The bond between bacteria and leguminous plants was carefully studied, but outside this case which was considered rather unique than rare, any schizomycete which might attack a higher plant was judged to be some kind of infective micro-organism or other. The researches of VON FABER on *Mycobacterium rubiacearum* in the genus *Pavetta*, of MIEHE on the bacteria *foliicola* and *repens* in *Ardisia crispa*, of GEORGEWITSCH on the leaf nodes of *Kraussia floribunda*, of CAUDA on *Bac. cruciferae* and finally the author's own researches on the root bacteria of *Diplotaxis erucoides* and of *Calendula officinalis*, all mark a highly important change in the direction of the enquiry into bacterial symbiosis in plants.

Investigators of the biological significance of the union of a bacterium with a plant limited themselves to determining if such union constituted, or not, the medium for the utilisation of the elemental atmospheric nitrogen. Does the bacterium fix the nitrogen or not ?; and the discussion ended there. This question is not, however, a main consideration, as we have maintained and now maintain that, in symbiosis, not merely a single function, such as that of assimilating nitrogen, but many functions may be performed by one of the partners. In the cases investigated it was possible to prove that there was secretion by the bacterium of proteolytic and amylolytic diastases, by which the circulation of nitrogenous substances and carbo-hydrates in the body of the plant may be greatly influenced.

It is, accordingly, undoubtedly desirable to take wider views in

regard to bacterial symbiosis in the higher plants and this conviction has been confirmed by further researches, whereby it was possible to ascertain the presence of bacteria in the roots of a great number of phanerogams.

Bacteria have been found in Caryophyllaceae, Chenopodiaceae, Compositae, Cruciferae, Euphorbiaceae, Gramineae, Labiatae, Malvaceae, Papaveraceae, Poligonaceae and Solanaceae; diffused in the thickness of the cortex, in some cases in the outermost zone of the bast, in the intercellular spaces and even in the interior of the cells; this occurring in 75 % of the species examined and in such numbers as to exclude all possibility of accidental presence.

The presence of these bacteria may have been non-essential but in view of the physiological conditions of the subjects examined it was doubtless advantageous; and in this sense we have described the fact as *normal*.

To this form of union between green plants and bacteria, newly discovered, we have given the name " *batterioriza* " (" bacteriorhiza ").

The infection — if it is permissible to call it so — is limited to a well defined zone of the root, namely the cortex and the outermost part of the bast, indicated as the *symbiotic region* or the zone of occurrence of these inter-relations of the common life of the different organisms: beyond that zone no more bacteria are traceable, and in the so-called *metasymbiotic* region is begun the biophysical and biochemica evolution of the useful and useless products of their cumulative metabolism.

That the forms giving rise to this " bacteriorhiza " should constitute a single fixed species, whether for a given family or a given group of plants, is inadmissible. It is probably a question of *physiological types*.

Some stocks, behaving functionally in a similar if not identical, way, differ by the intensity of the attack: it is a case, so to speak, of micro-organisms of the same functional type; though it is not very easy to say whether the similarity is an original or an acquired characteristic.

In the case of other stocks which show more marked differences of functional activity it is doubtful whether they should be attributed to different species, which, happening to find themselves in identical conditions of life, have come to show the same activity in a greater or less degree.

In the first case we have phenomena of adaptation *in divergence*,

in the other *in convergence* and, this, with varying degrees of divergence from a common stock of origin or of approach in similarity made by a number of originally differing types: in either case that equilibrium which is the condition of bacteriorhiza results from it.

The accompanying diagram will make this clear (Fig. 48).

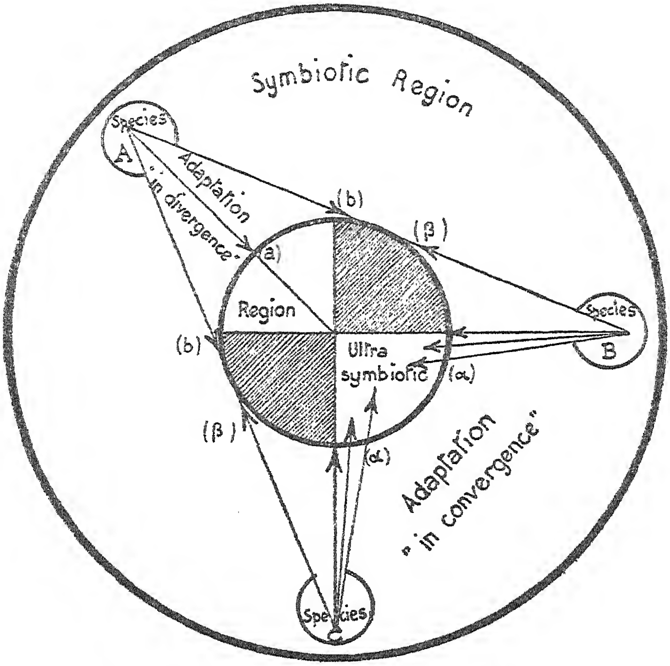

FIG. 48. — Diagram of the adaptation of forms in " bacteriorhiza ".

The individuals of species A, in unfavourable struggle with the physiological activities of the plant, adapt themselves to a limited extent and in small numbers to the conditions of life of the symbiotic region into which they have penetrated; and while one part, indicated by the arrow a, enters into symbiosis, the greater part avoids adaptation exhibiting abnormal characters, as indicated by the arrows b forming tangents to the ultra-symbiotic region.

The individuals of the different species B and C, undergo this adaptation more easily, and even if to a certain extent they follow the part marked by the tangential arrow B, for the most part

they come out victorious in the struggle with the plant which is their host, as indicated by the numerous arrows, drawn into the orbit of its functional activity, assuming morphological and physiological characters to a great extent similar and determining the bacteriorhizical equilibrium.

The sectors cross-hatched indicate the reunion and superposition of influences of the symbiotic individuals of all the species *A*, *B*, *C*... which re-inforce each other's value.

* * *

In typical mutualistic symbiosis alimentary exchanges take place directly between the organisms thus united ; but very similar relations may exist without any morphological bond, so that a greater or less reciprocal dependence may arise between two or more separate organisms. Hence the distinction between *conjunctive* and *disjunctive* symbiosis.

Disjunctive symbiosis has not yet been duly considered, except from a general and speculative stand point for some limited cases. It deserves, however, a much fuller investigation, since it does not fall within the scope of this article to consider the cultivated plant in itself, as did the " humists " and the " mineralists ", but in intimate connection with all the biological environmental factors influencing its growth, and in particular micro-organisms. Disjunctive symbiosis conduces to the formation of food material ; it induces changes in nutritive soil and in the surrounding medium ; it determines specific actions of certain products and of certain secretions. Thus unassimilable substances become assimilable ; and while toxic secretions or elaborations of certain substances determine the occupation of the soil as between competing forms, other products render possible catalytic or chemiotactic influences or exercise a stimulating effect on exchanges of matter in very many lower and higher forms of plants. Numerous observations have abundantly shown that in the environment surrounding the root are evident, more or less intensively, attractive and selective influences of micro-organisms, the micro-flora thus appearing more numerous and more active. This peculiar environment we indicate as " *rhizosphere* " On the other hand it is evident that throughout the whole depth of cultivable soil, not directly in contact with the root, in relation to the proportion and composition of humic matter certain

remarkable and continuous relations of functional correlations are established in the micro-flora, such relations contributing more or less remotely to the metabolism of the higher plant.

There arise in such a way, between micro-organisms *combined effects* of great importance; effects simultaneous or successive, distinct or combined; with final results depending more often on multiple and variable conditions, always self-regulated. And, as in any specified organism, functioning occurs as the result of interaction of elements differing in form and function, so in the *great polymorph colony*, as which it is desirable to consider "*edaphon*", the great organic laws of the division of physiological labour and of correlativity are undoubtedly at work. The conception of agricultural soil, as a *living unity* which has been ours for a long time, has found confirmation in successive researches and still appears fully justified.

But the combined influences do not and could not stop at the dividing limit between the external medium and the internal medium of the plant, *i. e.* at the cell wall of the root hairs. They find their complement in the diosmotic exchanges which take place through the cell wall; so that with the continuity of the anatomical elements of the root and of the rhizosphere, corresponds a functional continuity which starting *from the disjunctive microbe, may be considered as developing up to the elementary green organ.*

We have been able to show how the green plant modifies variously and considerably the environment of the micro-organisms in humus, bringing about in them a selection, which is reflected directly in the principal microbic functions of the soil and, consequently, in the functioning power of the plant itself.

Plant and micro-organisms therefore tend alike towards that functional equilibrium which, while subordinate to necessary and sufficient condition of the nutritive phenomena, even *without conjunction*, seems characteristically a form of symbiosis — the first step, that is, of specific relations between superior and inferior organisms in the soil.

Such relations may exist for each group of allied plants, in a defined area of soil which we have called the "edaphosphere".

* * *

As the final, elementary limit of phenomena of correlativity and therefore of the scale of all the symbiotic relations is to be considered the *chloroplast* and it is with its functioning, directly bound up with the *edaphosphere*, that the circle of the general evolution of matter in Nature is closed.

If we indicate by the term "histophere", the internal environment of the plant where conjunctive symbiosis can take place, we obtain the accompanying diagram (Fig. 49).

The "edaphosphere", that is to say the nutritive sphere of the soil, which teems with micro-organic life at the expense of the humic and mineral substances contained in it, — the seat for that reason of incessant biochemical changes, by which matter is made soluble and *induced* —, is tributary to the "rhizosphere" that is to say to the sphere of soil adjacent to the roots of a plant with chlorophyll, where the micro-organic development, influenced by the osmotic exchanges depending on root absorption, is increased and made *selective*.

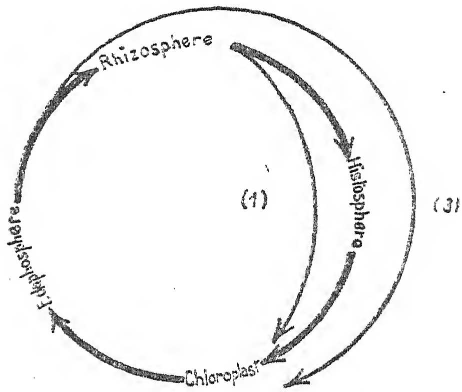

FIG. 49. — Simplified diagram of the relations between the micro-organisms and the given plant.

The "rhizosphere" in its turn is tributary to the "histosphere" that is to say to that area of the root tissues in which bacterial forms and fungoid forms assume close and direct relations of morphological and functional correlativity, so that such forms may be considered as having come to be part, in a special state of *equilibrium*, of one single organic entity, individualised in the harmonic complex of the absorbent, conducting, assimilating, and reserve systems of the plant.

Direct relations of the edaphosphere and of the rhizosphere with the chloroplast itself are not however to be excluded (indicated in

the diagram by tracings 1 and 3), since they depend on two facts of capital importance :— *that the edaphosphere and the rhizosphere constitute the source, perhaps the most important source, of carbon dioxide for the plant and the histosphere is part of the organs of synthesis of the complex substances.*

There are *terrestrial plants* and *aërial plants* -- aërial, in the sense that they have a crown of foliage and spread their branches on high, utilising the smallest quantities of carbon dioxide; while the others, accustomed to higher tensions of this gas, remain low, creeping and with thick leaves and utilise directly the carbonic dioxide which is formed in the soil. The gas in fact circulates from the atmosphere to the soil and from the soil to the atmosphere, meeting, in both passages, defined organs of synthesis and of transformation which are in the histosphere.

It follows that it is indispensable to consider the necessity of encouraging such gaseous exchange which, in conjunction with the complex of the very important phenomena above described, neither humists nor mineralists took into consideration; sometimes they had no suspicion of it, and at other times denied it in more or less good faith!

* * *

We may summarise, thus, in the accompanying diagram (Fig. 18).

The diagram shows primarily the edaphosphere, the general sphere of elaboration of the foods for the plant.

It includes immediately the rhizosphere, the particular sphere of elaboration of the actual foods, in which the processes become more active and selective.

We pass next into the internal environment of the plant distinguished in the histosphere and in the ultra-symbiotic region. The attack of the symbiotic bacterium is limited to the histosphere where it succeeds in finding its conditions of *equilibrium*. In it are realised three different degrees of conjunctive symbiosis :—

(1) *bacteriorhiza* (PEROTTI);
(2) *mycorrhiza* (TRANK);
(3) *Organorhiza* (tubercles, mycodomazi, bacteriodomazi).

In the meta-symbiotic zone the tissues of the plant are immune from the attack of any micro-organic form whatever and in them

are elaborated the products of the separate activities, as conjunctive activities of the symbiotic organisms with the centre of gravity of the phenomena: the assimulating organ — the chloroplast.

Taking all these facts into consideration, the limits of the biological enquiry in soil science are easily perceived.

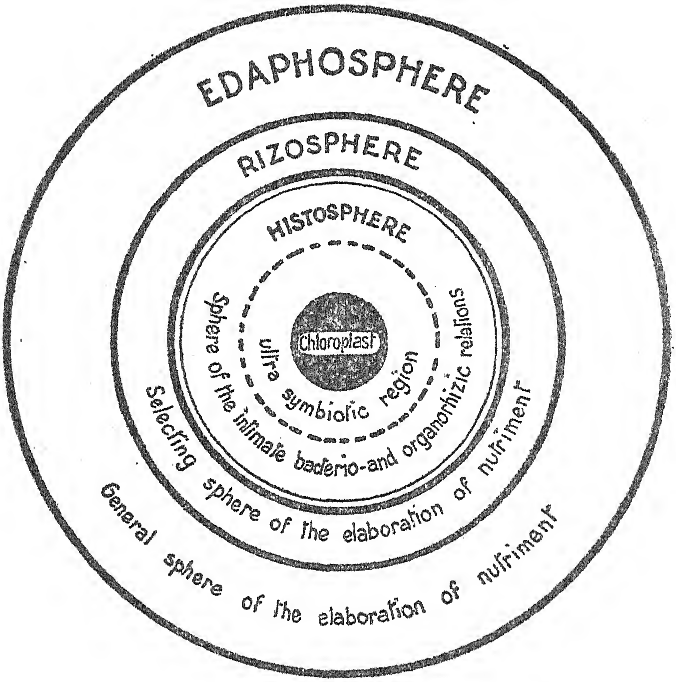

FIG. 50. — General diagram of the symbiotic relations in Nature with reference to the nutrition of plants.

The organic world cannot be conceived as resulting from distinct, and perhaps not even from fixed units. Every phenomenon is the consequence of another vital phenomenon which has preceded it: thus a *form* finds its reason for existence in another form — apart from the question of *origins* which does not concern us here. The cultivable soil is thus considered as a living unity, with its skeleton, more or less broken down, and its morphological elements, more or less differentiated — the whole in the most harmonic complex that can be imagined.

No absolute and crude separation should be made, as is done

in the technical operations depending on our theoretical speculations, between one element and another which in Nature exist in a fruitful correlation, nor is such separation intended here.

Therefore the biological study of the soil should pass on beyond the limits of the edaphosphere to the more intimate limits of the histosphere; from the microbe scarcely influenced by the surplus products of the life of a determined species, to the microbe which has found its way into the convolutions of the structural joints of the green plant until that condition of equilibrium is reached which binds them more or less indissolubly together.

And thus the chloroplast is reached, the ultimate expression of the activities of synthesis which in conjunction with the opposing activities of analysis constitute the tangible aspect of that eternal interplay which is life, the succession of all lives. It was thus justly resolved to include in the general theory of *soil science*, the section of plant physiology. Human thought moves by induction and by deduction; science progresses with analysis and with synthesis. Every time that in the history of physiology, as of science, one or the other of the methods is observed to prevail, the results prove fallacious. Progress is only there, where deduction is blended with induction and analysis harmonises with synthesis. Let us conform our enquiry to this criterium at the same time rendering homage to the supreme law of the indestructible harmony of Cosmos.

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PEROTTI R. — Sulla presenza di una specie batterica nelle radici della "Diplotaxis erucoides" D. C. *Rend. Acc. Lincei*, Vol. XXVIII, Ser. 5, 1. halfyear, No. 9, p. 331.

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PEROTTI R. — Ancora sui bacilli radicali della " Diplotaxis erucoides " D. C. *Rend. Acc. Lincei*, Vol. II, Ser. 6, 2. halfyear, Nos. 1 and 2, p. 46.

PEROTTI R. and CORTINI-COMANDUCCI J. — Normale presenza di batteri nelle radici di numerose fanerogame. *Rend. Acc. Lincei*, Vol. XXXI, Ser. 5, 2. halfyear, No. 10, p. 484.

PEROTTI R. — La " batterioriza. " *Rivista di Biologia*, Vol. V, No. 4.

PEROTTI R. and ZAFFUTO G. — Sui bacilli radicali della " Calendula officinalis " L. *Rend. Acc. Lincei*, Vol. XXXII, Ser. 5, 1. halfyear, No. 2, p. 94.

PEROTTI R. — La teoria microorganica della concimazione. Publisher: Sapientia. Rome, 1925.

THE CARRASCO-PLANCHER APPARATUS IN SOIL ANALYSIS.

The CARRASCO-PLANCHER (1) apparatus for the elementary analysis of organic substances has proved of great service in this Laboratory of Agricultural Chemistry, where for some years it has been used for rapid determination of organic matter in the soil.

It would therefore seem not out of place to direct attention to its utility for chemico-pedological purposes and to give an account of certain modifications made in the apparatus, to render its construction and use easier and more certain.

The apparatus (Fig. 19) consists of a tube *a* of transparent quartz closed at one end, of an inside diameter of 25 mm. and a length of 240 mm. The tube is closed by a rubber stopper *e*, which is perforated by a metallic tube *b* of nickel, bearing on the one side a rheophore *g* and on the other a pipette *h* which conducts the combustion gases to the absorbing apparatus. Through this tubing passes a small quartz tube *d*, of an external diameter of 5 mm. and a length of 280 mm. The upper end of the quartz tube terminates in a bulb *n*, which isolates this metallic part from a second tubing *c*, also of nickel, furnished laterally with a rheophore *l* and internally soldered to a silver wire *m* of a diameter of 1.5 mm., which runs through the whole length of the lower metallic tubing and the small quartz tube. The two sets of tubing and the upper end of the small quartz tube are held together by a rubber tube *f*.

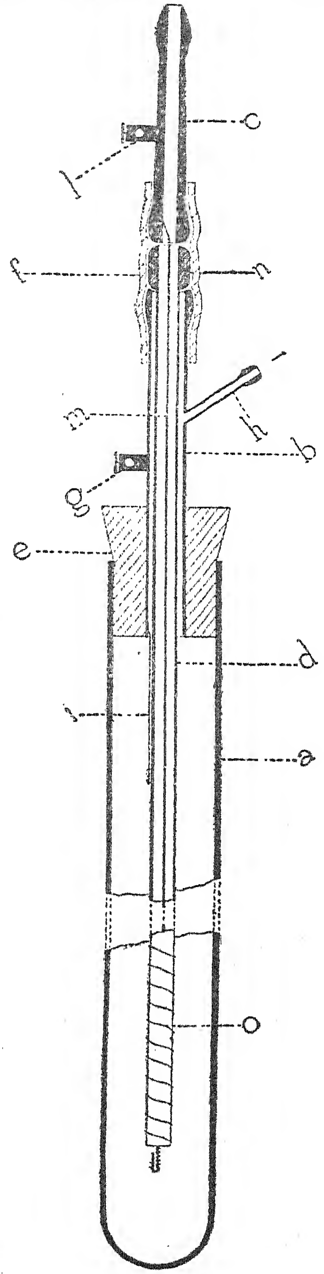

FIG. 51. — The CARRASCO-PLANCHER Apparatus for the elementary analysis of organic substances in the soil.

To the lower end of the silver wire is attached, by means of a platinum joint, a resistance coil *o* of platinum of a diameter of 0.35 mm., which is wound in a spiral on the outside of the small quartz tube until it reaches a second platinum wire *i*, soldered internally to the lower metallic tubing (2).

The analytical process for the determination of the organic matter in the soil is as follows :— Gm 0.5-5 of soil (to set free about gm. 0.2 of CO_2) are mixed in a mortar with gm. 1.5-15 of oxide of copper and with a little chromate of lead placed in the quartz tube.

If the soil contains carbonates it should be subjected to a preliminary treatment with warm dilute phosphoric acid, so as to drive off the carbon dioxide of the carbonates.

The stopper is fastened and the spiral is heated red-hot, then the CARRASCO-PLANCHER apparatus is connected with the absorbing apparatus; the current of oxygen is passed, heating at the same time the lower end of the quartz tube with a MECKER lamp.

Combustion is completed in about half an hour. A carbon content of 58 % is attributed to the organic matter in the soil (humus); multiplying the weight of the carbon anhydride by 0.273 we therefore get the organic carbon, and by 0.471 the organic matter in the soil.

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of the Laboratory of Agricultural Chemistry of the « Regio Istituto superiore agrario » of Milan.

NOTES.

(1) O. CARRASCO and G. PLANCHER. — On the new CARRASCO-PLANCHER method for determining the carbon and hydrogen in organic matter by means of electric incandescence. — *Gazzetta Chimica Italiana*, XXXVI, 1906, pp. 492-504.

(2) The apparatus is made by the firm ANGELO LIVRAGHI. Milan (28), Corso Como, 9.

Abstracts and Literature.

General.

Moor Science.

BÜLOW, K, v. *Moorkunde.* 142 pages. 20 illustrations. Sammlung Göschen, Vol. 916. Published by Walter de Gruyter and Co., Berlin and Leipzig, 1925.

The object of this manual is to state within definite limits and with reference to practical requirements the main principles of moor science so far as they can be said to be established. This is achieved in a commendable way, all purely theoretical or debateable subjects being omitted.

SCH.

Exact Soil Cultivation.

BURMESTER H. Die exakte Bodenwirtschaft.. A text-book for students and practical farmers. Published by Wilh. Gottl. Korn, Breslau.

The author has made soil cultivation the basis of a system of farming and explains in this book, basing his statements on his scientific experience of twenty years, the co-ordination of all the principles of "his exact soil cultivation", and the interaction necessary to bring about those high crop yields required by the needs of the present day from the farmer and from the farmland. The marked successes achieved by the author in the capacity of agricultural consultant, together with the practical advice he gives for securing large crops with comparatively little application of labour or fertilisers and a minimum of seed, give this book great value as indicating new departures in agricultural science.

SCH.

The Methods of Geology as a Historical and Biological Science.

WALTHER, JOHANNES. Fasc. 185 of the "*Handbuch der biologischen Arbeitsmethoden* (E. ABDERHALDEN)" Part X, 5. 45 illustrations. 1 Table. Published by Urban and Schwarzemberg. Berlin-Vienna, 1928.

This well-known writer gives in this work a comprehensive review of the process of formation of the earth's crust, as revealed by the rocks and the fossils found in them, as well as by the earth forms, both tectonic and superficial.

SCH.

Problems of the Earth and their Solution by the Law of Transformation of Energy.

ZUNKER F. Published by the Journal "*Der Kulturtechniker*" 9 illustrations. 1925.

It is impossible to review, or to discuss critically in the short space available, this book, dealing as it does with the important problems of the

origin of the earth, but very careful study may be recommended of a work which goes so deeply into these scientific questions. SCH.

Soil Physics.

Alkali Soil Investigations. Origin of Alkali Soils; Physical Behaviour under Treatment.

JOFFE J. S. and MCLEAN H. C. *Soil Science*, vol. XVIII, no. 1, pp. 13-30, Baltimore, 1924.

With due regard to the views of other workers the authors discuss the problems and the treatment of alkaline soils. The effects of the treatment of alkaline soils with alum and with peat, and the results of the oxidising action of sulphur, are discussed, particularly with regard to the rise of capillary water in the soil. L. G.

Contribution to the Knowledge of the Physical Properties of Soils.

SOKOLOWSKI H. N. and LUKASCHEWITSCH E. S. (Communication from the Laboratory for Soil Science of the Moscow Agricultural Academy).

Uspechi Agronomii. — Progress of Agricultural Science (formerly *Izwestija Selsko-chosjaistwennoj Akademii* — Yearbook of the Moscow Agricultural Academy), Vol. I, pp. 47-58; 1925).

The purpose of the investigation was to find the influence of salts on certain properties of soils. The experiments of K. K. GEDROIZ (1) and A. N. SOKOLOWSKY (2) have clearly proved that in this case the effect is not due to the salts themselves, as was formerly supposed, but to the cations absorbed by the soils. Thus the phenomena which we are investigating are closely bound up with the absorbent powers of soils.

In our experiments, 50 gms. of tschernosem (from the Kharkov Experiment Station, upper layer, 0.20 cm.) was placed on a funnel and washed with one per cent. normal solutions of NaCl, $MgCl_2$, $FeCl_3$ and with 0.05 % normal solution of HCl (after GEDROIZ). This washing was continued until the filtrate no longer gave the Ca reaction, and in this way the soil samples were saturated with different cations. During the filtration of the $FeCl_3$ solution a change of colour from yellow to red-brown was noticeable.

The soil has thus a considerable (catalytic) accelerating effect on the reaction $FeCl_3 + 3\,H_2O \rightleftarrows Fe\,(OH_3) + 3HCl$, The excess of reagents was removed from the sample by washing, but in the case of samples treated with NaCl and NH_4Cl, as it was not thought possible to use dialysis, the excess of reagents was removed by washing on a parchment-paper filter under diminished pressure. But it proved impossible to remove the

(1) *Russian Journal of Experimental Agricultural Science* 1908-1923

(2) *Moscow Agricultural Academy* 1919; *Intern. Mitt. f. Bod.* 1923; *Journal of Experimental Agricultural Science* 1921-1923.

last traces of NaCl as the filtration through the parchment-paper soon stopped. All samples were then dried (at 11° R).

The soil samples had the following appearance: those saturated with Na and NH_4 were hard, compact lumps, and the samples saturated with $CaCl_2$ and $MgCl_2$ solutions and particularly those samples treated with $FeCl_3$ and 0.5 normal HCl were loose and crumbled easily. At the same time and for comparative purposes a sample was prepared which had been washed with distilled water only and dried.

In the pressure-resistance experiments it was found very difficult to prepare test samples (test-cylinders) which would give, on crumbling, comparable numbers. At last, to ensure a uniformity of the test samples we used the following method: 10 gm. of soil, rubbed into a fine powder, were poured through a wide funnel into a glass-tube (6 cm. long and 2 cm. wide), particular care being taken that the upper surface should always be horizontal and the tube had been tapped with the finger. The soil samples thus prepared, were then saturated with water through capillary action and pushed out of the tube by means of a wooden piston. The soil cylinder was cut to about 3 cm. length, dried at 100° and crushed on Prof. Williams' apparatus. The following results were obtained:

Complete crushing of normal soil samples:

7,95; 8.85; 8.40; 8.85 kg. Mean 8.54 kg. Amplitude 15 %.

We also prepared test cylinders of soils, which had been saturated with different solutions by means of the above method, and also determined their resistance to pressure.

The capillary rise of water up to a height of 3 cm. took place in the different cylinders with different speeds.

	The Normal experiment with 0,99 % of displaceable $Ca^{··}$	The absorption capacity is saturated with the following cations					
		$H^{·}$	$Fe^{···}$	$Ca^{··}$ (1.1 repl.)	$Mg^{···}$	$NH_4^{·}$	$Na^{·}$
Rate of rise of water	3.5 mins.	2 mins.	2 mins.	3.5 mins.	5.5 mins.	10 hrs.	After 2 days 1.2 cm.; After 1 month 3 cm.
Water-capacity (in weight per cent.).	44 %	43 %	41 %	43 %	42 %	43 %	—

As the soil samples saturated with $Na^{·}$ behaved very peculiarly while saturating with water, the water becoming strongly coloured by dissolved humus, a different method had to be to devised for their preparation. A glass-tube was therefore filled with soil saturated partly with $Na^{·}$ and partly also with tschernosem which had been kneaded with water (after ATTERBERG).

The soil cylinders prepared in this way were dried at the ordinary

temperature in a vacuum desiccator over concentrated sulphuric acid, all changes which high temperatures produce in soil colloids being thus excluded. (The resistance to pressure of normal soil samples dried at 100°, was nearly half that of samples dried at ordinary temperature).

With the apparatus of Prof. WILLIAMS we obtained the following results as to the resistance under pressure of our different soil samples :

	Sample cylinders prepared by our method						Samples according to ATTERBERG	
	Unchanged samples	Samples saturated with cations of					Unchanged	Saturated with Na
		Ca	Mg	H	Fe	NH_4		
Appearance of cracks	8.85 kg	6.0	16.5	2.3	0.75	—		
	9.3 »	7.5	—	2.1	0.75	—		
Complete crushing . .	15.0 »	10.2	29.3	4.5	3.75	—	30	Not crushed even by a weight of 150 kg.
	16.5 »	11.7	30.5	4.8	3.3	70.5		

Taking the resistance to pressure of a normal sample of blackearth (*tschernosem*) as 100, we get for the soils saturated with different cations the following numbers:

Saturated with.	$Fe^{\cdot\cdot\cdot}$	$H^{\cdot}$	$Ca^{\cdot\cdot}$	$Mg^{\cdot}$	$NH_4^{\cdot}$	$Na^{\cdot}$
Resistance to pressure .	22	30	70	180	440 $>$	440

In the action of 0.05 n. HCl we are undoubtedly dealing with the influence of the $H^{\cdot}$ on the soil colloids as well as with the influence of the $Fe^{\cdot\cdot\cdot}$ extracted from the soil.

Only in this way can we explain the remarkable similarity of the results obtained in the case of soil samples treated with either 0.05 n. HCl or 1.0 n. $FeCl_3$ solutions. In both cases not only the $Fe^{\cdot\cdot\cdot}$ ion but also the iron oxide soil is active, and the coagulating action of the latter is not removed even on washing with soda.

We have also determined the plasticity and the capacity of our soil to be rolled out. The samples saturated with $Na^{\cdot}$ gave on rolling a thin, elastic ribbon which could be bent very easily, while the soils saturated with $Fe^{\cdot\cdot\cdot}$ gave, on the contrary, very fragile thick cylinders. The normal sample and those formed with soils saturated with $Ca^{\cdot\cdot}$, $Mg^{\cdot\cdot}$ and $NH_4^{\cdot}$ were average in this respect and no noticeable differences were remarked among them.

Similar results were obtained in the water-content determinations when the limit of rolling has been reached.

Soil sample saturated with	$Na^{\cdot}$	Normal sample	$NH_4^{\cdot}$	$Ca^{\cdot\cdot}$	$Mg^{\cdot\cdot}$	$Fe^{\cdot\cdot\cdot}$
Water content (Limit of rolling) .	21.9	25.1	27.1	27.8	28.3	28.8

Summary:—

(1) The absorbed cations have a different effect on the physical properties of the soils which absorb them.

(2) The resistance and plasticity of a soil are increased by replacing the absorbed $Ca^{\cdot\cdot}$ by $Na^{\cdot}$ somewhat less so, if replaced by $NH_4^{\cdot}$ But if the $Ca^{\cdot\cdot}$ ion is replaced by $Fe^{\cdot\cdot\cdot}$ these properties are not very strongly marked.

(3) The capillary properties of and the rise of capillary water in a soil are inversely proportional to its resistance to crushing.

AUTHORS.

The Mechanics of Earth Structure from a Soil-physical Basis.

TERZAGHI K. 399 pages, 65 illustrations. Published by Franz Deuticke, Leipzig and Vienna, 1925.

This work is of greater value to the soil scientist than the title would seem to indicate. It is based on A. ATTERBERG's researches into the physics of the soil, but it also contains the results of the author's own researches in the same subject, which undoubtedly constitute a contribution to science.

This applies particularly to the following chapters: Structure and pore volumes of soils; thermal properties of soils; consistency and coherence of soils; the frictional forces in the soil; the caking tendency in binding soils; the water content of air free clayey soils, as a function of the loading of the soil surface; the relation between loading and the pore index of sands when there is no possibility of lateral expansion; the adhesion of binding soils; the relations between the tenacity indices, the internal pressure and internal frictional resistance; the permeability of soils; the statical effects of running ground-water; the capillary rise of soil-waters; the evaporation of the soil-waters from the surfaces of clay layers; the thermodynamical equation to express the time course of hydrodynamic tension phenomena; approximations for the numerical treatment of tension balance in binding soils.

The last two chapters on " soil statics " and on " the soil as building land " are of special interest to engineers.

A brief mention only can be made here of this important work, which contains the tabulated results of numerous experiments. It should be in the hands of all soil scientists.

I. STINY.

Chemistry and Agricultural Chemistry of the Soil.

The Estimation of Nitrate Nitrogen in Rain-water, Drain-water and in the Soil.

HANSEN F. Om Bestemmelse af Nitratkvälstof i Regnvand, Drænvand og Jord. (*Tidskrift for Planteavl*, Vol. 32, p. 69-119, 1926).

The author has investigated the different methods of nitrate nitrogen estimations and recommends the "Devarda" method, in the modified form, as devised by the chemical laboratory of the Rothamsted station. The Phenol-sulphonic method gave too uncertain results. No doubt, for rapid estimations, the phenol method is the best, but to get accurate results not more than 0.1 gm. of nitrate should be used, and the results obtained should be corrected by the formula

$$N = 1.06 \text{ N (found)} + 0.33.$$

The investigations show that the nitrate concentration of drain-water is largely influenced by the precipitations. The nitrate concentration falls very considerably after a heavy rain and rises to its normal value in dry weather, until fresh precipitation again disturbs the equilibrium.

This article is a communication from the Askov Experiment Station, where the laboratory analyses of soil samples prove that nitrification is more intensive on plots treated with stable manure than on those treated with artificial fertilisers. K. A. BONDORFF.

Comparative Experiments on Different Methods of Estimation of Phosphoric Acid in Soils.

HISSINK D. J. with collaboration of DEKKER M. (Vergelijkend onderzoek van eenige methoden ter bepaling van het gehalte aan phosphorzuur in de grond. Published by the *Landbouwkundige Onderzoekingen der Rijkslandbouwproofstations*, No. XXX, pp. 142-161, 1925.

Three typical soils were chosen (clay soils with different contents of humus) and their phosphoric acid content was determined by a large number of the usual methods. The following are the conclusions drawn from the results obtained.

(1) The separation of silicic acid has no influence on the results.

(2) In the case of not heating to a red heat, the fact of destruction or not of the dissolved organic matter present in the soil is of great importance in the determination.

(3) Heating of the soil to red heat gives in all cases and with all methods higher figures.

(4) In the case of soils not heated to a red heat where the organic matter has been destroyed, the nature and strength of the acid, the quantity of soil used and the length of boiling are of the greater importance the more humus the soil contains. The importance of these factors is slight in the case of soils heated to redness where the boiling has been continued for some time.

After a critical review of the data obtained the following two methods A and B were adopted.

A. *Determination of the phosphoric acid soluble in acid.*

12.5 gm. of air-dried soil were rubbed to a fine powder and heated to redness in a platinum dish over a small flame for 5 hours, stirring it from time to time. The soil was then transferred into a 250 cc. flask and shaken up with 150 cc. of HNO_3 (12.5 %) and then heated in a glycerine bath for 75 minutes to a temperature of 105° C, the flask being shaken from time to time. When shaking the flask the glycerine in the bath was diluted with a little water. After the heating is completed the flask was cooled and the 5 cc. of conc. H_2SO_4 were added and the flask rapidly cooled. The flask is filled with water up to the mark, stirred and filtered. 50 cc. of filtrate are next taken and the phosphoric acid is determined by LORENZ's method by adding 50 cc. of molybdenum-sulphate reagent, and, after allowing to stand over-night, filtered through a NEUHABER funnel. The residue is washed on the funnel with NH_4NO_3 and acetone and dried for half-an-hour in vacuo. The volume of the soil is taken into account.

B. *Determination of the phosphoric acid soluble in citric acid.*

55 gm. of soil, air-dried, finely powdered, but not heated to redness, are digested at room temperature in the course of 48 hours, with repeated shaking, with 500 cc. of a 2 % citric acid solution. In the case of soils containing $CaCO_3$ 500 cc. of a stronger citric acid solution were used. 200 cc. (in the case of soils with more than 5 % $CaCO_3$ only 100 cc. of soil were used) were then evaporated in a porcelain evaporating dish on a water-bath and to oxidise the citric acid 5 × 10 cc. of NHO_3 (sp. gr. 1.4) were added. To prevent splashing the water-bath should not boil too vigorously. The residue is dissolved in 10 ccs of 10 % HNO_3 and in some hot water and filtered while still warm into a beaker, and evaporated to about 15 cc. on a water-bath. 35 cc. of a H_2SO_4-HNO_3 mixture are added (LORENZ) and while the solution is boiling the P_2O_5 in it is precipitated by the addition of the molybdenum-sulphate reagent (LORENZ).

The relative solubility of the P_2O_5 is equal to B : A.

v. d. S.

Investigations on the Influence of Calcium Carbonate on the Reaction of a Soil.

JENSEN TOVBORG S. (Undersøgelse over Kalciumkarbonats Reaktionsändrende Virkning i Jordbunden. *Tidskrift for Planteavls.* Vol. 31, No. 7, pp. 744-777, 1925).

The author set himself the problem to find whether it is possible to determine from the titration curve of a soil the quantity of lime to be added so as to bring its hydrogen ion concentration up to pH = 7.0. In this enquiry he relied to a great extent on his field experiments with graduated applications of lime which he had carried out over a number of years. The result of his laboratory experiments is briefly, that, to ascertain the quantities of lime required in actual field practice, the quantities calculated

from the titration curve (titration with $CaCO_3$) must be multiplied by the factor 3. He also finds that sandy soils require larger quantities of lime than loamy soils, to obtain the same rise in pH, and that there is a rough relationship between the pH existing at the moment and the amount of lime required for reaching pH = 7.0. He emphasises also very strongly that it often happens that very different quantities of lime may be needed on soils with the same pH to bring about the same reaction change. Thus two sandy soils, both of pH = 5.8-6.0, required, one 3000 kg. of $CaCO_3$ per hectare, the other as much as 32,500 kg. per hectare to bring the pH up to 7.0. Details cannot be given here, but the attention of soil scientists generally is drawn to this memorandum and it may be confidently asserted that with this work of the State Plant Cultivation Laboratory a new epoch begins in the study of the liming question. K. A. BONDORFF.

Alkali Soil Investigations: Chemical Effects.

JOFFE, I. S. and MCLEANS H. C. *Soil Science*, Vol. XVIII, No. 2, pp. 133-149. Baltimore, 1924.

The question is discussed how much sulphur has to be used to change the character of the alkaline soils, or to neutralise the soda which is either present or is being formed. The authors discuss also the question of the treatment of those soils with either alum alone or combined alum and sulphur. L. G.

On the Decomposing Action of Peat on Phosphorite.

PRIANISCHNIKOW D. (Moscow). *Fortschritte der Landwirtschaft*, I, No. 1, p. 1. Vienna, 1926.

The author first draws attention to the researches of FLEISCHER, KISSLING, KNIERIEM and others which proved that high-moor peat possesses the property of decomposing phosphorites, and that the quantity of phosphoric acids dissolved is increased by an admixture of the neutral salts of strong acids. Ca salts however in comparison with the K, Na and NH_4 salts tend rather to reduce such quantity, although in the opinion of the author this is only the case when the non-saturation of the peat, expressed in Ca, has passed a certain limit. With these conclusions in view the author carried out a number of experiments, which proved, that the acidification produced by the addition of $CaSO_4$ is larger than on the addition of KCl, and that the highest acidification i. e. the largest increase in the water soluble P_2O_5 occurred in the mixtures peat + phosphorite + $CaSO_4$ (pH = 4.0 against peat pH = 6.1). If 100 gm. of peat contained 0.01 gm. of water-soluble P_2O_5, then in the mixture it rose to 0.326 gm. This was the maximum figure for all experiments. On being allowed to stand the phosphorite solubility sunk from 46.17 % at the beginning to 29.17 % after four months. In the meantime about 63 % of the P_2O_5 in the phosphorite have been decomposed, because the $CaHPO_4$ formed has no effect either on the acidification or the solubility of the P_2O_5. If the ratio of phosphorite to peat is very large, e. g. 1:100,

the solubilities are even more favourable. Hence the question arises: could we not obtain the effects of superphosphate fertilisation if in its stead we supplied to the soil a mixture of 12 parts of 25 % ground phosphorite together with six parts of gypsum and 600 parts of ground peat? And in fact sand cultures of oats (according to HELLRIEGER) showed an exceptional utilisation of the phosphoric acid in the peat-phosphorite mixture. In the crops were found the following percentages of P_2O_5: without phosphorus: 0.10 %; phosphorite alone: 0.14 %; peat alone: 0.21 %; peat and phosphorite: 1.21 %; complete nutritive solution of HELLRIEGEL, 0.51 %. H. FISCHER.

Some Properties of Soil Colloids.

SOKOLOVSKI A. N. *Izvestia Petroskoj Selskochosjajstv. Akademii* 1919, *I-IV*, 85-275. *Moscow*. (Annals of the Agricultural Academy 1919 I-IV. Moscow).

The colloid part of the soil is its active fraction which determines the composition, physical and chemical properties and morphological character of the soil, that is, the nature of its profile.

Also the absorptive power is a function of the quantity of colloid clay and humus.

In connection with the conditions of soil formation the profiles of different soil types show quite characteristic curves of distribution of absorptive power, from top to bottom. The maximum of absorption in relation to ammonia is shown by black soil (tschernosem), with great decrease to N. and S. from the black soil belt.

The acidity of soils depends mostly upon a low degree of saturation of soil colloids with lime.

The amount of clay and of humus and also the structure of the soil, are in close connection with absorbed lime.

The possibility of the formation of black soils depends generally upon the content of lime in soil-forming deposits. In this relation an exceptional role belongs only to absorbed lime. The soil represents a system of unstable equilibrium between its colloids and absorbed lime. After removal of lime and washing with water striking changes take place: destruction of the crumb structure, swelling, reduction of its filtration-capacity, of consistence of the soil, and finally dissolution of soil colloids (black solutions from tschernosem).

These phenomena play a great part in nature to the North of the tschernosem belt, under the action of water, in combination with CO_2 and some other acids, as also in Southern (SE) countries, in the soils of which the losses of lime are due to replacement by soda.

Also, the content of absorbed lime is a regulating factor as regards the chemical as well as the physical properties of the soil.

The colloidal part of the soil is divided into two fractions: one, which is in continuous unstable equilibrium with absorbed lime and the other which is not connected in its properties with lime, but represents an insoluble combination of clay and humus; separation of that fraction from soil

is possible only by boiling with water (very incomplete) or, better by oxidation by means of H_2O_2. Those fractions are termed: active and passive slime (clay + humus). The former, containing absorbed lime, is a factor in good structure. This active slime is relatively great in black soil and very small in podsol, in close relation with lime content and physical properties of those soils. It is an analogue of "matière noire" when in a more natural state without the changes necessarily effected by the action of strong chemical reagents. Its importance for soil fertility depends in the first instance upon its influence on the physical properties of soil.

These phenomena form a basis for elaboration of a method of mechanical analysis of soil for the determination of conditions of good structure in our soils. The enormous importance of absorbed lime compels us to study not only its proportion in different soil types but even more the degree of relative saturation of soil in regard to lime. The top layers of black soil are most saturated by lime; lime is partially replaced by magnesium; sodium and potassium are not present in the absorbed state. In soils of semi-desert regions and especially in alkali soils, the degree of saturation by lime is very small because lime is replaced to great extent by sodium and magnesium.

The coefficient by expression of degree of saturation is calculated in this manner: coefficient = $\frac{am}{ka}$ (*am* and *ka* are proportions in which NH_4 and Ca are absorbed by soil from equivalent solutions of their chloride expressed in m-mol. for 100 gm. of soil). Different soil types have their own individual curves of changes of this coefficient in their profiles. This fact is a useful indicator of origin of soils or geological deposits.

The strikingly low degree of saturation of South-Russian loess (in spite of high $CaCO_3$ content) and enormous absorptive capacity in relation to lime is of great importance when attempting to form hypotheses of the origin of those deposits.

The absorbed lime influences to a great extent the absorption of P_2O_5. The process of displacement of absorbed bases and that of passing into solution are in the opinion of the author which differs from that of M. PARVER, qualitatively quite different; (by the action even of weak HCl solutions, Fe_2O_3 and P_2O_5 pass into solution). This may occur as a secondary phenomenon in the case of unsaturated soils. AUTHOR.

The Calcium Content of a Soil in Relation to its absolute Reaction.

SWANSON C. O., GRAINEY, P. L. and LATSHAW, W. L. *Soil Science*, Vol. XVII, no. 3, pp. 181-191. Baltimore, 1924.

The contribution deals firstly with the investigation of 293 soils of very different geological origins. The acidification of soils is primarily due to the removal of bases by washing-out in the process of weathering, the weathering process being hastened largely by the presence of organic substances in the soil. The soils were investigated in the following way: 25 gm. of soil were agitated in a shaking-machine, for several hours with

250 cc. of HCl in a 500 ccs. flask. The soil was then allowed to settle and, in three samples respectively: (1) the time was quantitatively determined, (2) the Hydrogen-ion concentration was measured, and (3) a nitrogen bacteria test was taken. The results show that there exists a relation between the calcium content and the pH index of soils of approximately the same physical character and of similar climate, and also, that in many cases the nitrogen-bacteria test reacts similarly. But the authors are of opinion, that in the case of unknown soils conclusions should not be drawn from results obtained from a single one of the three tests, and advise the carrying out of all three tests in all cases.

L. G.

Ground-water Movements and Stagnation Processes explained by Oxygen Analyses of the Ground-waters of North Swedish Moraines.

TAMM O. (Swedish, with a full German review) *Meddelanden från Statens Skogsförsökansialt*, 22, p. 1. Stockholm, 1925.

The North Swedish soils are covered in their greater part by peat. As already shown by HESSELMAN, water which has trickled through a layer of peat is free from oxygen. On the other hand, the water of normal moraine soils is rich in oxygen. By means of a mercury pump and of a specially constructed boring apparatus, the author was able to obtain water samples from different depths of moraine soils. In the process of pumping these water samples lose only very small quantities of the dissolved gases and the oxygen present was determined by WINKLER's method. It has been found, that while there are peat soils with moraine ground-waters free from oxygen beneath the peat, on the other hand there are peat-soils with ground-waters rich in oxygen. It was found that the moraine ground-waters under the peat of the fringes of peaty soils were always rich in oxygen, while on the same spot the waters of the lower peat layers were completely free from oxygen. By means of a large number of oxygen determinations in water samples taken from the fringes of peaty soils and from different depths and soil profiles, it has been afterwards possible to tell more or less exactly whether the given sample of ground-water came from a spot covered by, or free from, peat. Thus the determination of the oxygen content of samples of ground-water furnishes a means of determining the movements of the ground-water and consequently the process of stagnation. The analyses carried out gave data as regards these phenomena.

O. TAMM.

Experimental Studies on Chemical Processes on the Formation of Glacial Clay.

TAMM O. *Experimental Studies on Chemical Processes in the Formation of Glacial Clay.* (English). *Sveriges geologiska Undersökning.* Arsbok, 18 (1924), No. 5, Stockholm, 1925.

The glacial clays have been formed through the grinding of rocks (in Sweden very often granites and gneisses) by the melting of interstitial

ice, i. e. through wet grinding. The water formed by the melting ice must also contain dissolved carbon dioxide. The process is from a physico-chemical point of view very similar to the well known DAUBRÉE experiment. DAUBRÉE ground felspar in water, the liberated silicate being chemically decomposed to a large extent. The author carried out a number of experiments by rotating quartz flasks in a thermostat, the flasks containing a number of very small pieces of granite, pea-nut size or smaller, and also water, either free from or containing carbon dioxide. The granite was analysed very carefully. The rotation caused the pieces to rub against each other resulting in formation of clay. After 12 hours rotation the liquid was titrated and the dissolved bases estimated.

First were studied the general conditions of granite decomposition. As expected, the rate of decomposition was very nearly independent of the temperature, but depended to a large extent on the intensity of grinding and on the quantities of carbon dioxide ($= H^{\cdot}$ ion concentration present).

In two parallel experiments carried out on a larger scale, with and without carbon dioxide, the products, which were in one case clay and silt, and in the other dissolved salts, were investigated very carefully. The clays thus prepared are very similar to the natural glacial clays even as regards their chemical composition. The dissolved bases ($MgO + CaO + K_2O + Na_2O$) represented, in water containing carbon dioxide, 3.24 %, and, in water free from carbon dioxide, 1.17 % of the clay formed at the same time ($<$0.002 mm.).

The author was then able to calculate the content of the two clays in chemically dissociated minerals. He found: for the experiment with carbon dioxide 15,6 %, for the other 6,0 %. The analyses indicate a higher content in biotite in the clays artificially formed.

Some experiments with potassium felspar also indicated a large decomposition. This mineral must therefore also play an important part in the chemical processes taking place in the change of granite into glacial clay.

These experiments throw light, in some respects, on the chemical processes, taking place in the formation of glacial clay, and furnish a method which may enable us to clear up the processes of hydrolysis and decomposition of the silicate minerals. O. TAMM.

Biology of the Soil.

The Bacteriological Sulphur Oxidation in Pond Soils and its Practical Importance.

FISCHER H. *Zentralblatt für Bakteriologie*, II, p. 35, 1925.

The formation of SO_4'' ions in pond waters and in pond soils appears to be of the greatest practical importance, as by their means we may be able to recover from the soils the insoluble phosphates lying there inactive. It has been found necessary in all pond manuring experiments to introduce PO_4 ions into the water and in most cases, this has been done by using either

different sulphates or fertilisers physiologically acidified by means of SO_4, but it can be brought about just as well by natural bacterial sulphur oxidation. This sulphur oxidation is chiefly caused by autotrophic micro-organisms. Their action is facilitated by alkalinity of the soil and of the water, and inhibited by acidity of these media. The experiments were made with pure sulphur, sulphides, thiosulphates, sulphites and sulphuretted hydrogen. From all these sulphur compounds considerable amounts of sulphates were obtained by means of bacteria. But under certain circumstances, e. g. in sewage sludge, there takes place a reduction of sulphites and thiosulphates to sulphides. In the case of weighing experiments by passing through a current of air and sulphuretted hydrogen, with the calcareous soils only energetic oxidation took place and retention of sulphur as newly-formed sulphates. In the event of weak oxidation the sulphuretted hydrogen passed through the vessel with the soil and soil suspension and then passed through attached flasks containing a caustic soda solution. In all experiments, about 10 % of the sulphuretted hydrogen could not be recovered. This percentage must have been retained in the soil either biologically or by purely chemical action.

AUTHOR.

The Influence of Hydrogen-ion Concentration on Bacteriological Processes.

GERRETSEN F. C. Over den invloed van de waterstofionen concentratie op bacteriologische processen. Verslagen van *Landbouwkundige Onderzoekningen der Rijkslandbouwproefstations*. No. XXX, pp. 1-44, 1925.

In the determinations of the hydrogen-ion concentration in biological solutions one is restricted almost solely to the use of the colorimetric method.

The author describes an arrangement called by him a bicolorimeter by which the pH may be exactly determined without the use of a "buffer" solution even in small quantities (0.25 cc.) of solution whether coloured or turbid.

For less exact determinations an ordinary colorimeter was devised using a small basin, which contains the different indicators in the yellow (acid) form and in sufficient quantities.

The pH values obtained by this colorimetric method in the case of centrifuged aqueous soil suspensions were sufficiently in agreement with the values obtained by the electrometric method with the same suspensions to justify its use in practice for pH determinations. The pH values of soil extracts obtained by PARKER's method of filtration or percolation are unreliable. With regard to the influence of the hydrogen-ion concentration on the nitrite and nitrate bacteria, the author's experiments prove. that in culture solution the nitrite formation lies between pH 5.6 and 9.7 with an optimum between 7.8 and 8.2; the limits of nitration lie between pH 5.2 and 10.0 with an optimum between pH 8.3 and 9.2. However, the limits of nitration appear to be conditioned by the character and

place of origin of the bacteria. It has been found in addition that the influence of the hydrogen-ion concentration on bacteriological processes depends to a large extent on the mode of preparation of the culture medium.

Experiments with soil suspensions and soils proved that in those media nitrification may bring about much lower pH values (as low as 3.5) than in pure cultures, and moreover that nitrification depends not so much on the number of bacteria, as on the original pH value and the extent of the buffer action of the soil.

In the author's opinion it is possible by means of nitrification experiments to conclude up to what point $(NH_4)_2SO_4$ may be added to a soil before it becomes acid.

In alkaline soils there may occur an accumulation of nitrite because of the slowness of nitrification. This accumulation of nitrite as well as the process of formation of the nitrite itself are influenced to a large extent by the water content of the soil.

In conclusion the author proves by means of experiments that in the process of nitrification both in the soil and in culture solutions an acid is formed which is capable of dissolving insoluble phosphate. Whether this dissolving does take place depends on the amount of acid, on the original pH value and the extent of buffer action of the soil. v. d. S.

Alkali Soil Investigations: Chemical and Biological Effects of Treatments.

JOFFE I. S. and McLEAN, H. C. *Soil Science,* vol. XVIII, no. 3, pp. 237-251. Baltimore, 1924.

The authors describe, in respect of the soil solutions of variously treated alkali soils, the reaction, the content in plant nutritive material, and the bacterial numbers. The influence of each soil on plant growth is also indicated. L. G.

A Contribution to the Biology of the Thiosulphate Bacteria.

KLEIN G. and LIMBERGER, A. *Biochemische Zeitschrift,* Vol. 143, p. 473, 1923.

Bacteria can live aerobically on inorganic as well as organic nutrients. They are capable of oxidising all forms of sulphur, and potassium nitrate is reduced by their action to nitrite and ammonia. Ammonium chloride also yields nitrite. Sulphur was deposited as rhombic crystals.

H. FISCHER.

Investigations into the Importance of Tree Mycorrhizae.

MELIN E. An ecological-physiological Study. With 48 illustrations in the text. Published by G. Fischer. Jena, 1925.

Contents: The state of our knowledge about the root fungi of trees; the root fungi in pure culture; tree seedlings in pure culture; tree seed-

lings and fungi in pure culture; conclusions as to the mycorrhizae of the conifers in nature; tables; literature. SCH.

The Relation between the Nitrogen-bacteria Test of a Soil and its Reaction Character.

PETERSEN ERIK, I. Undersgelse over Forholdet mellem Azotobacterproven og Jordens Reaktionstilstand. *Tidsskrift for Plantaeavl*, Vol. 31, pp. 246-336, 1925.

The nitrogen-bacteria test discovered by H. R. CHRISTENSEN was, as is well-known, of great importance in the investigation of Danish soils, the non-appearance of nitrogen bacteria indicating a lime shortage. The author has made a very thorough and exhaustive study of all the different factors conditioning the results of the test. He concludes that such results are influenced not only by the buffer action of a soil, but also by the nitrate content, the general microbiological structure and the quality of the inoculation material. The author lays special stress on the fact that it is impossible with ordinary inoculation to equalise the differences in the microbiological character of different soil samples, and he therefore suggests omitting the nitrogen bacteria test in future experiments and instead taking a titration curve of the soil and thence determining the lime requirements. The article is contributed from the State Plant Cultivation Laboratory. K. A. BONDORFF.

A Contribution to the Knowledge of Edaphic Mucorini in Jugo-Slavia.

PISPEK, A. (Prinos peznavanju edafskih mukorineja Jugoslavije). (Croatian with a review in French *Acta Botanica Instituti Botanici R. Universitatis Zagrebensis*. Vol. I. Zagreb, 1925.

Taking as basis HAGEM's and LENDNER's researches on mucorini the author investigated 270 soil samples from 200 different localities. He was enabled to isolate 40-50 different varieties. The soil samples were taken from the following different districts of Jugo-Slavia: Croatia, Slavonia, the Croatian Coast-land, Dalmatia, Herzegovina, Vojedovina Slovenia and Serbia. The soil mucorini varieties recognised by him with certainty were: *Mucor Mucedo, M. Ramannianus, M. flavus, M. racemosus, M. hiemalis, M. griseo-cyanus, M. sylvaticus, M. sphaerosporus, M. spinosus, M. circinelloides, M. Praini, M. stolonifer, M. Cambodja, M. arrhizus, Absidia cylindrospora, Ab. glauca, Ab. orchidis, Ab. Lichtheimi, Zygorhinchus Mölleri, Cunninghamella elegans.*

The author recognised many varieties of mucorini and considers that the occurrence of such a large number of varieties may be ascribed to the great heterogeneity of soil and climate in Jugo-Slavia. In the alpine districts, varieties are found which were isolated by LENDNER in Switzerland and particularly by HAGEM in Norway, e. g. *M. flavus, M. hiemalis, M. griseo-cyanus, M. stolonifer, Ab. cylindrospora, Ab. glauca* and *Ab. orchidis.* The other regions e. g. Karst, Pontic and Mediterranean regions are also distinguished by special varieties. In all these regions there are often

found representatives of the species *Cunninghamella* (2-3 varieties), more seldom of the species *Ab. Lichtheimi*. However, these three regions not only differ in their varieties from the Alpine districts, but they even differ among themselves. Thus, e. g. *M. Mucedo*, *M. Ramannianus* and *M. arrhizus* have been found only in the Karst region, *M. Praini*, *M. Cambodja*, and several not yet recognised varieties of the species *Absidia*, *Cunninghamella* and *Zygorhinchus* in the Pontic region only, and two varieties of the species *Cunninghamella* only in the Mediterranean region. In addition, these three regions are each characterised by the occurrence in them of preponderating numbers of one or the other common variety, thus the Mediterranean region is characterised by *M. stolonifer*, the Pontic region by *M. circinelloides* and the Karst region by *Ab. cylindrospora*.

In general, the most widely distributed variety on Jugo-Slavian soil is *M. stolonifer* (about one-quarter of all samples) and the least frequent are *M. Mucedo*, *M. spinosus* and *M. arrhizus*. After *M. stolonifer* these follow in the order of the frequency of their occurrence: *Ab. cylindrospora*, then *M. circinelloides*, then *Cunninghamella elegans*, *M. glauca*, *M. hiemalis* and finally *Ab. orchidis* and *Zygorhinchus Mölleri*. The other varieties are very rare.

In a future scheme of further investigations Bosnia and Macedonia will be included. A. SEIWERTH.

Regional Soil Science.

Precipitation, Drainage and Evaporation in the Region of the Sources of the Weser.

FISCHER K. *Jahrbuch für die Gewässerkunde Norddeutschlands.* Vol. V, No. 3. 4 illustrations, 5 tables. Published by E. S. Mittler and Son. Berlin 1925.

In this work the whole region of the sources of the Weser is dealt with in relation to rainfall, drainage and evaporation, excellent diagrams and maps being appended. Detailed studies of this kind are of the utmost value in connection with special work in geology or soil science.

SCH.

A Contribution to the Knowledge of the Properties and Degeneration of the Soils of the Brown-earth Type in Southern Sweden.

LUNDBLAD K. (Swedish, with a resumé in German). *Meddelanden fran Statens Skogsförsökanstalt.* 21, p. 1, 1924.

The brown earth type (following the nomenclature of RAMANN) is characteristic of the beech forest soils of Southern Sweden. Where conifer woods are grown on beech forest soils, podsolation or degeneration of the brown earth occurs, and at the same time productivity diminishes. The author carried out a series of comparative chemical analyses on normal brown earth profiles and on brown earth profiles somewhat degenerated by growth of conifer woods, and compared the results obtained with those of the same tests on true podsol profiles. In some cases mass analyses

were made, in others the gel complexes of the soil were analysed by the TAMM method : extraction of the soil sample with a previously determined solution of a slightly acid mixture ($pH = 3.25$) of neutral and acid ammonium oxalate. By this method the gel complexes in sandy soils can be dissolved out and the solutions analysed for SiO_2, Al_2O_3 and Fe_2O_3.

While the podsol profiles indicate a quite definite maximum of gel complexes in the mother rock, the brown earth profiles usually show a uniform distribution of these in the upper soil layers down to a depth of 40 to 50 cm., when the content in gels begins to decrease. As soon as a slight degeneration could be detected, the analysis showed a gel complex distribution very nearly similar to that in genuine podsol profiles.

A live rock profile was also investigated for the gel complexes. It was proved that though the cementing was fairly hard there was no large content of gels. A number of other facts of interest, relating to the chemistry of soil formation in Sweden, are established by the author.

O. TAMM.

Certain Directions for the Drainage of North Swedish Peat Soils.
MALMSTRÖM C. *Skogliga vön.* No. 4, Stockholm, 1925.

From a peat sample newly taken from a moor there is very little, and in some cases no flow of water. The large quantities of water present in peat samples are thus present as hygroscopic moisture, and may so exist under three forms viz. either as capillary moisture or in a colloid-chemical form, or in a purely chemical form. Capillary water is only found in considerable quantities in the slightly humified peat varieties. The hygroscopic water of the strongly humified peat varieties is present in a chemical or colloid-chemical form, as can be readily shown.

The permeability of the different peat varieties to flowing water is very different. The author has carried out experiments to determine the relative permeabilities of the different peat varieties. It appears that the strongly humified peat varieties are absolutely impermeable, in their deeper layers, to flowing water, while the deeper layers of the weakly humified varieties are permeable to considerable quantities of water.

In view of these properties of the different peat varieties it may be *predicted on theoretical grounds* that, where strongly humified peat varieties exist, two ground water levels (groundwater free water) will be formed. One exists in the upper, loose, layers of the peat and very often evaporates in summer, the second layers exist in the sandy subsoil (e. g. moraines) layers of the peat. On account of the loss of water by evaporation during the dry season this ground-water level can be found somewhat below the peat. In the case of the weakly humified peat varieties however only one ground-water level is formed, but it will be in constant communication, through the whole peat mass, with the ground-water of the sub-soil.

The above theoretical conclusions were confirmed by field experiments, in the case of the different peat varieties. On the basis of many exhaustive researches into peat soils, which to a large extent have already been pub-

lished (1), and taking into account previous experiments in the drainage of peat-soils, the author was able to give a number of theoretically and empirically established directions for the drainage of such soils. Many failures in the drainage of peat soils will it is hoped be prevented if when planning, care is taken to determine the structure and the permeability of the peat varieties, which can be easily effected by means of a quite simple field examination.

O. TAMM.

Researches on Soil Reaction and the Cartography of the Degree of Acidity, in the Fields of the Experimental Farm of the College of Agriculture and Sylviculture of Prague at Netluky Uhrineves.

NĚMEC A. and GRACANIN M. Studie o povaze a význam reakce půd a mapováui pozemků dvora Netluky školniho závodu vysoké zemědělsa kého a lesniho inzěnýrstir v Uhřiněvsi. Sborník Výzkumnýck ústavů zemždělských, Vol. VII. Edition. Ministry of Agriculture of the Czecho-Slovaýekian Republic at Prague, 1925. (With a review in French and one map).

In the present paper, the writers have studied the nature of the soil reaction on the Netluky experimental farm near Uhřiněves in Bohemia, attached to the College of Agriculture and Sylviculture at Prague. The results of these researches have been expressed on a chart of the reaction of the soils investigated. The reaction, varies from pH=5.8-7.5 in soils under cultivation, specially adapted for the growth of the sugar beet and wheat, and between pH = 6.1-7.5 in the grasslands. On the farm investigated no soils were found of extreme acidity. From the results of chemical analyses it appears that there is no precise relation between the total lime content and the soil reaction; however, the most acid soils contain the lowest amount of lime. It is possible to observe the influence of the manures applied during recent years on the reaction of the soil: — lands manured by means of physiologically alkaline manures (carbonate of lime, nitrate of soda, basic slag and farmyard manure) show a tendency towards a more basic reaction than those on which physiologically acid manures (sulphate of ammonia, kainit) have been applied in a preponderant measure. It should be remarked that superphosphate adjusts itself in the soil like a physiologically neutral manure.

By comparing the yields of different crops with the reaction of the soil some interesting relations can be established.

The yields of sugar beet on acid soil are found to be very inferior. With decreasing acidity of the soil, the yields of beet increase; on the more alkaline soils, however, they again decrease. Yields of wheat vary inversely with the acidity of the soil. Barley generally obeys the same law.

(1) C. MALMSTRÖM: Degere Stormyr. A botanical, hydrological developmental investigation into a North Swedish moor complex. Swedish and German. *Medd. fr. Statens Skogsförsöksanstalt*, XX, 1923, pp. 1-205. Stockholm, 1923.

Variation in the hydrogen ion concentration of the soil	Yield in quintals per *hectare*		
	Sugar beet	Wheat	Barley
6.0 — 6.90	234	16	—
6.55 — 6.80	280	19	23
6.65 — 6.70	310	—	26
6.35 — 7.20	340	—	21
5.90 — 7.30	280	21	26
6.75 — 6.90	300	24	22
6.40 — 7.30	315	21	21
6.90 — 7.30	280	—	23
7.15 — 7.30	300	22	26
7.10 — 7.40	245	25	—

Entirely different relations have been found for potatoes : the yields increase as the acidity of the soil increases : —

Variations in the hydrogen ion concentration of the soil	Yield in quintals per *hectare*		
	Potatoes	Oats	Rye
6.0 — 6.9	—	25	20
6.25 — 6.55	95	23	20
6.75 — 6.80	—	24	—
6.75 — 6.90	—	—	22
6.70 — 7.30	50	21	—
6.80 — 7.25	50	—	22
7.10 — 7.40	40	22	21
7.10 — 7.50	36	—	—

On strongly alkaline soils (pH 7.5) the yield of potato tubers was partic larly small.

As regards oats, the highest yields were found on the most acid soils. Rye showed its capacity for giving good yields over the whole range of the soil reactions examined, the optimum yield however corresponds with the highest hydrogen ion concentration of the soil.

Investigation of the physical properties of the soils examined brought into prominence the relation of the degree of acidity or alkalinity of the soil with the absolute capacity for air, determined by Prof. Kopecky's method. The most acid soils showed the lowest value of absolute capacity for air, whilst the optimum corresponds with very slight acidity of the soil (pH = 6.8.)

Thence, the increasing alkalinity of the arable soil is in inverse function to the absolute capacity. for air : —

Reaction of the soil in pH	Absolute capacity for		Remarks
	moisture	air	
6.35	36.36	3.80	—
6.36	29.68	3.36	—
6.35	50.06	9.38	Grass land
6.40	49.34	10.41	Grass land
6.59	33.13	14.07	—
6.60	30.51	11.80	—
6,73	26.91	10.84	—
6.75	26.52	14.70	—
6.81	36.03	18.36	—
6.84	29.65	17.68	—
6.97	40.01	15.02	—
7.25	39.29	12.57	—
7.25	48.57	10.22	—
7.31	28.25	8.89	—

As regards porosity, the existence of similar, though less precise, relations between it and the hydrogen ion concentration of the soil can also be remarked.

The changes of physical properties and especially of the absolute capacity for air and porosity have a notable influence on the yields of agricultural crops.

The investigation of the relations of the soil reaction to the presence of weeds has shown interesting results. Weeds such as *Sonchus laevis, Veronica serpyllifolia, Sinapis arvensis* and *Raphanus Raphanistrum* are found on soils of acidity varying between pH 5.8-7.5. The presence of *Centaurea Cyanus, Dianthus Armeria* and *Achillea Millefolium* has been noted only on slightly acid soils (pH = 6.3).

On the other hand, weeds such as *Galium Aparine, Taraxacum officinale* and *Tussilago Farfara* have been met with only on neutral or alkaline soils.

The writers consider that the last two plants are indicators of neutral or alkaline reaction of the soil.

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General Notice.

E. Ramann †. On 19 January 1926 there died at Munich at the age of 75 the Nestor of Soil Science, E. RAMANN, a life of great usefulness being brought to an end by a sudden heart failure.

EMIL RAMANN was born on 30 April 1851 in Dorotheenthal near Erfurt, being the seventh child of his parents. His father was greatly interested in natural sciences and until the boy went to the Higher School his instruction was carried on by the parents, the mother being a Hamburg lady of great cultivation of mind. After the father's death, his unfinished work on butterflies was prepared for publication by the young RAMANN. He himself took up pharmacy and devoted himself to chemical studies in the Hamburg State Laboratory. Subsequently he studied chemistry and science at the University of Berlin; in 1881 he graduated at the University of Rostock, his dissertation being entitled: " Untersuchungen über die Passivität des Eisens ", while in the previous year he had received his first appointment as assistant at the Eberswalde School of Forestry.

In 1880 he was given charge of the chemico-physical practical course. In 1885 he took rank as a lecturer, while in 1886 he became director of a

department of the Prussian Forestry Experiment Station and in 1890 professor.

In the year 1900 he was appointed at the University of Munich as the successor ot EBERMAYER in the chair of Soil Science and Agricultural Chemistry, which he filled up to 1 December 1925. He was at the same time Director of the Soil Science Institute of the Bavarian Forestry Experiment Station and was also honorary president of the Soil Science Research Institute which he had organised with funds raised in Germany and from other countries.

On the occasion of RAMANN's seventieth birthday a communication by E. A. MITSCHERLICH relating to his life and work appeared in this Review,.

A vivid recollection of RAMANN's impressive figure will be retained by many of those present at the last Soil Science Congresses. Widely known and honoured as pioneer in the domain of Soil Science, RAMANN took a keen interest in those institutes which came into being after the war, and their unqualified success afforded him special satisfaction in the last years of his life. He was fully convinced that in soil science the advance of scientific knowledge is only possible if there is close collaboration between all countries of the most various climatic and soil zones. It was partly due to RAMANN that after the war scientific intercourse was so speedily and generally renewed, both in correspondence and personally. This was especially noticeable in his championship of his Russian fellow congressionists.

The writer, who was one of RAMANN's students and an assistant of many years standing, feels that in responding to the invitation to contribute this account of him he should begin with RAMANN's life work for the development of general soil science, known as it was to all his fellow workers in the subject. The stages through which the science has passed and its present situation are fully expounded in the three editions of his basic work on soil science. Not so well known may be his essays which deal with his more restricted sphere of work as Professor of Forest Soil Science.

Mention should also be made ot the experimental work planned on far-sighted lines which RAMANN during the last years of his life was able to undertake at the Soil Science Research Station with a view to the elucidation of certain fundamental problems. He accomplished this work up to a certain point but was not able to see the publication of the results.

RAMANN's world wide reputation was made by his book on Soil Science, which first appeared in 1893 under the title of "Forstliche Bodenkunde und Standortslehre". With the second edition in 1905 his interest had been transferred rather to the general sphere of Soil Science and he set before himself the aim of bringing together all that was previously known of the soil, and grouping the material along well defined lines.

Where he observed gaps, he made his own investigations and imparted a stimulus to others. Dr. J. HISSINK says of him: "RAMANN saw problems and knew how to attack them successfully".

When to his sure scientific sense it was clear that gaps could not be filled from existing knowledge, he used to bridge the subject in a provisional way, thanks to remarkable synthetic powers. For this he could rely upon his experience of many years, work on the soil in its pristine condition and

PLATE XI.

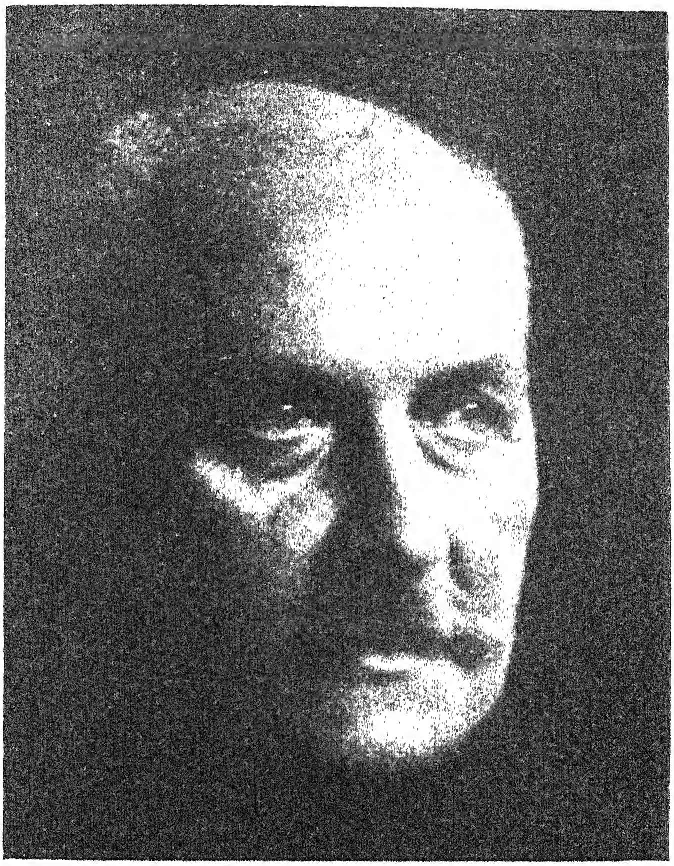

FIG. 52. — RAMANN †. Born 30 April 1851 at Dorotheental near Erfurt, died at Munich 19 January 1926.

upon the lively intuition which he had acquired through his keen observation and acutely critical intelligence in the course of yearly journeys taken to all parts of the continent of Europe.

In this way from a number of single observations, even though gaps occurred, causal connections of the processes of soil-formation and transformation could be worked out, and by taking into account the results gained by other research workers it became possible to develop a consistent conception of natural processes in the soil and to state fundamental principles.

Hence a beginning was made of a systematic construction of the whole subject, and the recently developed branch, soil science, now became a science in itself, independent of geology and agricultural chemistry (E. A. MITSCHERLICH).

During the twenty years at the Academy of Forestry, RAMANN made the study of the soil in its pristine condition the main point of his experimental work. As is well known, in civilised countries such soil is practically only to be found in forests.

At the University of Munich he devoted himself, so far as opportunity allowed, to the work of applying the advances in general scientific knowledge, especially in physical and colloid chemistry, to the problems of soil science. This new direction of his studies is very clearly reflected in the third edition of his Soil Science, published in 1911, though much that appears there had to remain in the form of provisional statements, and soon became out of date owing to the rapid progress made by science in general.

Although for a long time this third edition was out of print, and after the war was reprinted only in unrevised form, RAMANN could not decide to bring out the new work, which was generally looked for, without first making a comprehensive study of the present situation of the general theory of soil science. Unfortunately, fate did not allow him the opportunity of carrying out this project. In the first place, the isolation of the scientist, during and after the war, had prevented all study of foreign scientific works, and when the literature of the subject was again available as a whole, RAMANN's interest and energy were fully occupied by the Soil Science Research Station which he had founded in 1919.

He was very anxious to be relieved of his work of teaching, but this could only be arranged on condition that he relinquished all part in the direction of the Institute. His sudden death, a few months after his resignation of his professorship, is the more regrettable on account of the non-completion of his book, RAMANN having been a master of the general theory of Soil Science with all its border territories, whereas his younger colleagues are more or less compelled to specialise.

The articles contributed by RAMANN on the various branches of soil science, and forest chemistry are about one hundred in number, published in various reviews. The following is an account of some of the most important of these.

He began with researches on the circulation of mineral substances of the forest trees indigenous to Germany. By means of numerous ash-analyses further light was gained as to the extent of the utilisation, by the different types of timber, of the nutritive material in the soil, and at the same time

important knowledge was acquired as to the withdrawal of these substances from the forest, as the result of timber and firewood requirements and removal of litter. These studies are to be found throughout the *Zeitschrift für Forst- und Jagdwesen.* In the *Jahrbücher der Preussischen geolog. Landesanstalt* for 1884 and 1885 there are inserted articles on weathering of diluvial sands and on the formation of mother rock.

Next follow investigations of soil in the pristine state, as for example, into the circulation of water in different forest soils.

In 1887 RAMANN wrote the section 'Forstliche Standortslehre' in LOREY's handbook on the science of forestry.

He then made a detailed study of the cover or litter transformation and humus formation in the forest, in particular the question of raw humus; the work of RAMANN, taken in conjunction with that of others, P. E. MÜLLER, etc., effecting a radical change in the views originally prevailing in Germany on these subjects. RAMANN also gave attention in this connection to the subject of moor formation.

RAMANN was among the first to examine thoroughly the reciprocal action between the soil and the natural plant cover.

In 1901 he brought out a treatise on European soil zones. Then followed proposals for classification and nomenclature of the humus materials and further essays on moors and slime deposits.

In 1910 his first essay on colloid chemistry was published, and in 1911 an investigation of the life history of the small animals in the German forest soils.

Some years before a new cycle of work was instituted by RAMANN and his school relating to the absorption of the mineral substances from the soil by forest plants, special attention being paid to the annual intake of nutritive material and to the consequent "body building" as well as to the restoration of this nutritive material to the soil by the autumnal fall of leaves. This was followed by chemical investigations for the study of soil solution.

In 1918 a small volume appeared: "Bodenbildung und Bodeneinteilung" (soil classification), a short treatise on climatic types of soils from the standpoint of economic geography and the history of civilisation.

During his last years of life, articles appeared on the importance of carbon dioxide and hydrolysis in weathering, on the buffer action of bicarbonates in the soil, and a longer discussion on "Umsetzungen in heterogenen Systemen" (Influencie of Solubility) as well as essays on the importance of lime in the soil and several articles on questions of acidity.

In the article on the buffer action of the bicarbonates RAMANN emphasises very strongly, on the basis of some unpublished results of experimental work and their physico-chemical value, the conception of the harmful weathering or disaggregation' (*die schädliche Verwitterung*) which is caused by *pure* solutions of carbon dioxide. This *schädliche Verwitterung* is counteracted by the bi-carbonates. The recognition of this fact throws light on the important part played by calcium carbonate in the soil.

Among the work published in part only are RAMANN's articles representing several years' work on permutite, an artificial water-containing clay sili-

cate, which, as a 'model' substance to some extent chemically defined, was used, instead of natural clays, by various investigators for quantitative examinations into soil chemical transformations. In close connection with some published work on exchange of bases, there are in existence some still unpublished experimental researches into permutite debasification (removal of the bases in permutite) as the result of the action of carbon dioxide, and on the relation of this process to the various forms of acidity. (E. RAMANN and H. JUNG).

A comprehensive work on the dispersoid physical and chemical conditions of the exchange of bases in permutite (E. RAMANN and J. DANZL) is also unpublished.

Collected articles by RAMANN on quartz suspensions will appear in the *Kolloidchemische Beihefte* for 1926. They cover more than ten years of separate research on chemically cleaned quartz powders of known granular composition and surface development. These cleaned and sedimented quartz particles have proved an experiment medium, sufficiently indifferent chemically and physically as a dispersoid, valuable both for the study of electric charge and discharge phenomena (by electrolysis, in particular below the threshold value of flocculation) as well as for adsorption investigations. By the introduction of these quartz powders, RAMANN made possible exact colloidal chemical researches into natural soil processes, reduced to the most simple case, and under forms admitting of calculation and of microscopic observation.

RAMANN laid great store by these studies on quartz suspensions and it was a very real satisfaction to him that he was able in the last few months of his life, thanks to the devoted work of his colleague, H. SALLINGER, to see the experiments completed and the work at least to some extent collated.

Although the non-completion of the fourth edition of the Bodenkunde is greatly to be regretted, full concurrence may be expressed with what was said of RAMANN by the representative of the University of Munich at the cremation:

"He attained all the objects which he placed before himself in his profession".

As marks of professional recognition may be mentioned his appointment as member of the

Russian Academy of Sciences,
L'Académie d'Agriculture de Suède,
Scientific Forestry Societies of Finland,
Hungarian Academy of Sciences

and as

Honorary President of the International Soil Science Congress 1922 and 1924.

The Higher School of Forestry where he passed the first part of his scientific career appointed him in 1923 to a honorary doctorate in Forestry —

"as founder and first teacher of modern soil science and establisher of the scientific regional study of forestry" (*Standortslehre*).

G. KRAUSS,
Tharandt—Dresden.

The International Society of Soil Science. — *Session of the General Committee of the International Society of Soil Science.* Groningen, 10 a. m. 7 April 1926. Commissiezaal, Harmonie.

Present :

Prof. Dr. K. GLINKA, Honorary member.
Dr. Jacob LIPMAN, President.
Dr. D. J. HISSINK, Acting President and General Secretary.
Prof. Dr. F. SCHUCHT, Editor of the Review.
Dr. NOVÁK, Chairman of the First Commission.
Prof. Dr. Alexius A. J. VON' SIGMOND, Chairman of the Second Commission.
Prof. Dr. Eilh. Alfr. MITSCHERLICH, Chairman of the Fourth Commission.
Dr. H. R. CHRISTENSEN, Representative of Denmark.
Dr. Sl. MIKLASZEWSKI, Representative of Poland.
H. J. PAGE, Representative of England.
Prof. J. HENDRICK, Representative of Scotland.
Dr. B. A. KEEN, Representative of the British Colonies.
Dr. K. ZYLSTRA, Auditor

and as guest : Prof. Dr. N. M. COMBER from Leeds.

Prof. Dr. O. LEMMERMANN (Germany) and J. J. GIRSBERGER (Switzerland) were unable to attend. Dr. BORGHESANI, librarian, arrived the following day.

ORGANISATION OF THE SOCIETY.

Statement of Accounts.

		Fl.
Received up till 1 January 1926 :		
363 Foundation members (1924)		1897.77
283 entrance fees 1925	fl. 714.33	
589 members subscriptions' 1925	» 3825.04	
		4539.37
Contribution of the Czechoslovakian Government.		72.75
Received for the Reports of the Fourth Conference (Rome 1924) .		209.20
		6719.09
Outstanding for 1925 :		
24 entrance fees at fl. 2.50 = ...	fl. 60.00	
77 yearly subscriptions (part payments) . . .	» 477.53	
		537.53
		7256.62

Expenses up to 1 January 1926:

Expenses of the International Committee of Soil Science from April 1922-May 1924 (Prague, Zurich, Rome)				325.00	
Commission FROSTERUS-WIEGNER-GESSNER . . .				25.49	
					350.49
Expenses Groningen 1924:					
Printing	fl.	53.50			
Correspondence	»	66.65			
Secretarial expenses	»	120.00			
Cost of translations	»	80.00			
			fl.	320.25	
International Reports on Pedology			»	713.18	
					1033.43
Expenses Groningen 1925:					
Printing, paper, etc			fl.	128.74	
Archives etc			»	215.00	
Correspondence			»	205.35	
Secretarial expenses			»	384.50	
Cost of translations			»	138.00	
Contribution journey Berlin			»	42.50	
					1114.09
Editorial Office Berlin					474.26
Commission WOLFF, MITSCHERLICH, NOVAK, von 'SIGMOND . .					244.41
Contributions sent to Rome for the reports of the Fourth Conference (Rome 1924)					222.61
International Institute of Agriculture 691 Members' subscriptions fl. 2.00			fl.	1382.00	
Reprints, Statutes, Circulars, etc.			»	116.00	
					1498.00
					4937.29
Due Commission STOKLASA and GIRSBERGER					100.00
					5037.29

Balance to 1 January 1926.	fl.	6719.09
	»	5037.29
	»	1681.80
Outstanding Debts 1925	»	537.63
	»	2219.33

The auditor, Dr. ZYLSTRA, passed the accounts as in good order with full discharge of the General Secretary.

The General Secretary made the following statement of the expenses per member:

1. Charges for collection of subscriptions			0.50
2. Review expenses			
(a) Institute Rome	fl.	2.00	
(b) Editorial Office Berlin	»	1.00	3.00
3. Expenses in connection with secretaryship, Groningen .			2.00
4. Expenses in connection with Commissions			0.50
5. Not recoverable etc			0.50
yearly contribution per member			6.50

The General Secretary stated that collection of subscriptions, registration of new members and changes of addresses entailed too much work. It was decided decided to form in the separate countries national sections, which will be responsible for this part of the work. For the following countries the following addresses can be given:

Germany: Prof. Dr. SCHUCHT. Güntzelstrasse 59. *Berlin-Wilmersdof.*
Denmark: Dr. H. R. CRISTENSEN. Planteavls-Laboratorium. *Lyngby.*
Spain: Sr. D. Emilio H. DEL VILLAR, Lista 62, 3° der. *Madrid.*
United States of America: Prof. Dr. Jacob LIPMAN, Experiment Station. *New-Brunswick,* New-Jersey.
England and Dominions: Dr. B. A. KEEN, Rothamsted Experimental Station. *Harpenden,* Herts.
Hungary: Prof. Dr. A. von 'SIGMOND, Technische Hochschule. *Budapest I,* Szent-Gellerter 4.
Italy: Dr. G. A. R. BORGHESANI, International Institute of Agriculture. Villa Umberto I. *Rome* (10).
Norway: Doc. Johs. LINDEMAN. Landwirtschaftliche Hochschule. *As.*
Dutch-Indies: Dr. BERNARD. Algemeen Proefstation voor Thee. *Buitenzorg.* Java.
Poland: Dr. Slaw. MIKLASZEWSKI. Rue Szopena 6. *Warsaw.*
Russia: Prof. A. A. JARILOFF, Wosdwyenka, 5 Gosplan. *Moscow.*
Czechoslovakia: Dr. V. NOVÁK, Chef de l'Institut Pédologique, Kvetna 19. *Brno.*

Letters received:	1924 — 233
	1925 — 1006
Letters sent:	1924 — 258
	1925 — 533

The General Secretary proposes that the costs of sending out Part A of the Proceedings of the Second Commission (amounting to fl. 258.88) shall be paid by the International Society of Soil Science. Approved.

A telegram from the International Institute of Agriculture in Rome was received, requesting that a representative be appointed to attend the General Assembly of the Institute, to be held from 19-26 April in Rome. Dr. LIPMAN was chosen.

Review. The editor, Prof. Dr. F. SCHUCHT, stated that up to the present he had not been able to give collective reviews of the soil science publications in the separate countries. The reviews have, for the time being, been grouped under the headings of physics, chemistry, etc. The editor added that the numbers have been late in appearance while comments have been made as to the technical and linguistic mistakes occurring in the translations. After a long discussion, the President of the Society is commissioned to talk over the matter with the President of the International Institute of Agriculture in Rome. The following resolutions as regarding the Review are passed:

1. To express our thanks to the President of the International Institute of Agriculture in Rome for having the Review printed and published on such advantageous terms for the Society.

2. To ask that the revision and translations of the Review be executed with the utmost care.

The technical revision of the translations of the original texts can only be satisfactorily undertaken by soil scientists of the country, where the language of the translation is spoken.

It is advisable that the first proof in each language be sent to a soil scientist, who would act as sub-editor. This latter should be chosen in consultation with Prof. SCHUCHT, for France, England and Spain. For the Italian and German texts Dr. BORGHESANI and Prof. SCHUCHT will take the responsibility.

3. The Committee learns with pleasure that the Review will appear more regularly in the future.

At the end of the discussions a vote of thanks was tendered to the editor of the Review.

THE FIRST CONGRESS OF SOIL SCIENCE, U. S. A. 1927.

The President, Dr. LIPMAN, made the following statement:

(1) Several societies in America have offered their moral support to the Congress.

(2) The President of the United States, Calvin COOLIDGE, will send a message to Congress giving his consent to the invitation of the delegates of the different countries.

(3) Accordingly, the American Organising Committee will recommend to the Governments to appoint as delegates certain soil scientists, and to nominate the members of the Executive Committee and of the General Committee, as well as the members of the Committees of the different international Commissions.

(4) An endeavour is being made to collect 60.000 dollars, to be employed as follows:

(*a*) \$5000 for the Secretariat;

(*b*) \$5000 for the Congress proceedings;

(*c*) \$5000 for the Exhibition;

(*d*) \$45.000 for the expenses of 150 official members taking part in the excursions to be arranged after the Congress (\$300 per person).

(5) An endeavour is being made to obtain hotel accommodation in Washington at reduced tariffs.

(6) Committees have been formed in the various States to collect funds for the Congress.

The President, Dr. LIPMAN, gave the following outline of the prolonged excursion to be arranged after the Congress:

It is intended to make an excursion from Washington to California, which will last about 4 weeks and which will be cost free for those members who are not resident in the United States of America.

The minimum cost of the Congress will be about:

Europe-NewYork and back	\$250.00
New York-Washington and back	\$ 20.00
Hotel expenses Washington	\$ 40.00
Extra expenses	\$ 90.00
	\$400.00

It seems advisable to publish this estimate of the cost as soon as possible and to mention it in the letters of invitation.

It should be noted that the excursion is only gratis for those members who are soil scientists, and not for ordinary members of the Congress. The American Organising Committee will discuss this point with the General-Secretary.

Members of the International Society of Soil Science will not pay any extra contribution to the Congress.

Date of the Congress. The A. O. C. (American Organising Committee) intends to hold the Congress in Washington in June 1927. Some countries proposed September, others June. Dr. LIPMAN will inform the A. O. C.

Programme of the Congress.

It was decided to recommend to the A. O. C. the following arrangements:

(*a*) Three days for the meetings of the Commissions;
(*b*) Two days for the Plenary meetings;
(*c*) One day for the final session (passing of the resolutions);
(*d*) One day of rest.
(*e*) One day for short excursions.
(*f*) One day for the Exhibition;
(*g*) If possible one day for the discussion of the Russian reports.

Programme of the Commissions.

First Commission. The NOVÁK Commission proposes to meet in 1926 in order to draw up the programme.

Second Commission. (von 'SIGMOND Commission). The programme of this Commission will appear in part B of the Groningen Proceedings.

Third Commission. The STOKLASA Commission intends to meet in Berlin in June 1926.

Dr. WAKSMAN has drawn up a provisional programme of the questions to be discussed by this Commission: 1. Direct methods of microbiological examination of the soil. 2. Cultural methods of the microbiological examination of

the soil. 3. Soil population. 4. Fixation of nitrogen in the soil. 5. Transformation of nitrogen in the soil. 6. Transformation of the organic substance in the soil. 7. Transformation of the mineral elements in the soil. 8. Soil Biology, seen from an agronomic standpoint.

Fourth Commission. The President of the Fourth Commission, Prof. MITSCHERLICH, and the Vice-President, Dr. ZYLSTRA suggest the following programme:

1. Determination of the materials of plant nutrition in the soil.(physiological methods).

2. Influence of the reaction of the soil on plant yields.

3. Plant stimulants and plant poisons in the soil.

Fifth Commission. The provisional programme of subjects for discussion is given in an appendix (see below).

Sixth Commission. No announcement is yet made as regards the Girsberger Commission.

Finally, the programme of the Bureau of the delegates of the Russian soil scientists was announced by Prof. GLINKA, who asked that one day of the Congress might be devoted to the discussion of the following programme:

1. Historical summary of the development of soil science in Russia; 2. Soil morphology; 3. Classification and scientific grouping of the soils; 4. Physical and chemical properties of soils; 5. Humus of the soils; 6. Soil Mapping; 7. The dynamics of soils; 8. The genesis of soils; 9. The post-tertiary deposits and soils; 10. Application of soil science to agronomy, to land surveys, to division into soil regions, to land settlement and improvement.

Further, that an exhibition should be organised as follows to show the soil types of the U. S. S. R.

1. Monolytes of the principal types and varieties of the U.S.S.R. in several zones; 2. Collected samples of the soil profiles; 3. Collection of the morphological characteristics of the soils; 4. Soil maps and plans of different regions in Russia; 5. Literature; 6. Drawings and sketches of apparatus invented by Russian soil scientists.

Finally it was unanimously decided to propose to the Congress in Washington that the second Congress should be held in Russia. If it proves impossible for the Congress to be held in the latter country, the votes of the General Committee will decide between Germany and Poland.

Dr. D. J. HISSINK,
General Secretary.

Appendix. Provisional programme of the Fifth Commission for classification, nomenclature and mapping of soils, by Prof. MARBUT, Washington.

I. *Classification of soils.*

1. The extent to which the geology of the archaic rocks is to be used as a basis for the division of the soils into units or groups of units. 2. The extent to

which the climate of a region and its natural vegetation can be used as a basis for the division of soils into units or groups of units. 3. The extent to which the situation or other geographical circumstances form a basis for the division of the soils into units or groups of units. 4. What significance should be attached respectively to field observations and laboratory characteristics of soils in the statement and definition of the different categories in a comprehensive scheme of soil classification. 5. The extent to which the quantity and nature of the organic soil substance can be used as a basis for the division of soils into units or groups of units. 6. Should the different categories in a scheme of soil classification be founded on soil characteristics or on the forces and conditions under which the soils are formed? 7. General review of the soil in the narrower sense (*solum*) and its profile forming parts. Discussion of the term "soil", changes in its appearance, according to the development of the profiles. Description of different profiles in the soils of the world, relative importance of the appearance, conclusions from the various descriptions of sections and maps exhibited. 8. Submission of proposed schemes of soil classification on the basis of the appearance of soil profiles. 9. Conclusions and Recommendations.

II. *Soil Nomenclature.*

1. Soil nomenclature in the United States of America. 2. Soil nomenclature in Canada. 3. Soil nomenclature in Mexico. 4. Soil nomenclature in the South American countries. 5. The extent to which the present soil nomenclature can be used in designating the different categories in a comprehensive scheme of soil nomenclature. 6. The extent to which a uniform international soil nomenclature is possible. 7. Statement and discussion of proposed systems of soil nomenclature by members of the Commissions. 8. Soil colours and their nomenclature.

III. *Soil Mapping.*

1. Proposal of a uniform colour scheme for the soil survey maps of all countries. 2. Discussion and final establishment of those geographical and general soil conditions, which are to be marked, besides the soils, on the special and the survey maps. 3. The degree of specification to be attempted for the soil survey maps.

Meeting of the First International Commission at Rothamsted. — To the Members of the International Society of Soil Science. With reference to the circular, we have the honour to inform you that the meeting of the First International Commission will be held at Rothamsted in the month of October.

The very important question of International Methodology will be discussed and the resolutions to be submitted to the First International Congress at Washington will be prepared.

Members intending to take part in the Rothamsted meeting are requested to communicate with the Chairman of the Commission Dr. V. NOVÁK (Brno, Kvetna 19, Czechoslovakia) up to the end of June.

The definitive programme of the Rothamsted meeting will be sent later on to those members only who have signified their intention of being present.

Yours faithfully.

Brno, May 4th 1926.

Dr. Ladislav SMOLÍK,
Secretary of the First International Commission.

Dr. Václav NOVÁK,
Chairman of the First International Commission.

International Society of Soil Science (Pedology). Subscriptions. — The annual subscription for 1926 has been fixed at ƒ 6.50 (Dutch guilders) New members pay an entrance fee of ƒ 2.50, i. e., a total of ƒ 9.— (Dutch guilders).

Members are requested to forward to me before 1 May, 1926, the sum of ƒ 6.50 — or ƒ 9.00 for new members — being the subscription for 1926.

There are still a great many members who have not yet paid the annual subscription for 1925 *(ƒ* 6.60 *or ƒ* 9.00 *guilders, as the case may be), although three separate circulars have been sent to them, calling attention to this point. These members are urgently requested to forward the money for* 1925 *by return.*

In countries where National Sections have been formed, it will be best for the annual subscription and entrance fee to be collected by these Sections.

Members receive the Proceedings and other publications of the Society gratis.

New members who desire to receive Volume I (1925) of the Proceedings, should apply to Dr. G. A. R. BORGHESANI, International Institute of Agriculture, Villa Umberto I, Rome (10).

New members are requested to send me their exact address, typewritten, and to inform me at the same time in what language (French, English German, Italian or Spanish) they desire to receive the Proceedings.

Finally I should be glad if members would work for the formation of National Sections and report to me on the composition of the executive committees.

Groningen, February 1926.

Dr. D. J. HISSINK,
Acting Chairman and General Secretary, Groningen (Holland), Herman Colleniusstraat, N° 25.

Requests to members.

(1) to form National Sections;

(2) to pay their subscriptions through these Sections or, where such Sections do not exist, to me;

(3) to pay their subscriptions for 1926 by 1 August at the very latest;

(4) with regard to joining the various Commissions, to communicate with the respective Presidents;

(5) to communicate with Dr. BORGHESANI in the event of having any complaints to make as regards the forwarding of the Proceedings.

Groningen, February 1926.

Dr. D. J. HISSINK,
Acting Chairman and General-Secretary, Groningen (Holland), Herman Colleniusstraat, Nr. 25.

Archives of the Society. — With the object of finally arranging the Archives of the Society under the following Sections :—

1. Publications ;
2. Documents ;
3. Maps ;
4. Photographs, drawings, and similar material ;
5. Schedules, forms, etc.,

the Members of the International Society of Soil Science are asked to send direct to the undersigned, all material already available, lately published or still unpublished, relating to Soil Science, whether their own personal work, or otherwise.

The Service of the Archives of the Society will then prepare the slips relating to such material for the card index.

This Service can also supply all bibliographical information, copies of documents and printed matter at cost price.

Dr. G. A. R. BORGHESANI,
Librarian of the Soil Society,
Scientific Service of the International
Institute of Agriculture.
Villa Umberto I., Rome.

Reconstruction of the Library of the " Laboratoire d'Agronomie Coloniale " (Paris).

Professor Auguste CHEVALIER, Director of the " Laboratoire d'Agronomie Coloniale " makes an urgent appeal to the Members of the International Society of Soil Science to help him to reconstruct the library of the laboratory which was destroyed by a fire last June. The library consisted of more than 20.000 treatises and manuscripts collected during a period of 30 years.

PROCEEDINGS OF THE INTERNATIONAL ASSOCIATION OF POULTRY INSTRUCTORS AND INVESTIGATORS

Abstracts.

New Experiment on the Influence on Growth of the B Vitamin and its Quantitative Demonstration.

ABELS H. *Klinische Wochenschrift*, 2nd. July 1925.

It has been shown that animal tissue, in respect of cell absorption and assimilating power, depends in the greatest measure on the presence of vitamins, and particularly the B vitamin, so that a lack of this vitamin causes great deterioration in these essential functions of the tissue.

A new experiment of ABEL shows the great detriment to another tissue function, also dependent on assimilating power, namely regeneration, or the regenerative growth.

Two pigeons were first fed for a week with polished rice and water, the feathers were then plucked out of a part of the left side of the breast, and from then both pigeons were given one gramme of dry yeast. With one pigeon the yeast was previously heated to 130° C. for 5 hours, and thereby the B vitamin destroyed. The re-growth of the feathers with the pigeon provided with the B vitamin was very luxuriant; with the pigeon without vitamin there was no re-growth.

It is possible that this method will also be useful for further differentiations of the B vitamin, which probably represents a group- of substances.
B. J. C. te H.

Spreading Poultry Tuberculosis in Domestic Fowls.

ARNOLD ALWIN. *Zeitschrift für Fleisch- u. Milchhygiene*, Fasc. 5, p. 71. Oschatz, 1924.

As is known, the skin of our domestic animals, together with the muscles, is not very liable to tuberculous disease. Tuberculosis has been observed in parrots, on the head, in the form of horn-like tubercles, but the hen is not mentioned in the manuals.

ARNOLD now describes skin tuberculosis in a hen of a master butcher, who fed his poultry with tuberculous parts of the meat, and thus infected the whole run. The skin showed, for the most part, specially prominent on the back and the breast, callous elevations the size of a pfennig piece, 3-10 mm. thick, partly flat, partly knotty. This compact, fibrous growth of the cuticle, which contained isolated cheese maggots, some ray-like, some round-oval, radiated into the muscles and joints.

Tuberculous ulcers were also visible. Tubercle bacilli were indicated. It is a case of regional, fibrous skin tuberculosis, set up by infection through sores. B. J. C. te H.

On the Relations between the Rhythm of Respiration and the Rhythm of the Heart in Birds.

ARTOM, CAMILLO. *Archives Néerlandaises de Physiologie de l'homme et des animaux.* Vol. X, 3rd. Fasc. p. 362. The Hague, 1925.

An investigation of the relations between the rhythm of respiration and the heart rhythm in the case of those birds whose search for food is conditioned by frequent and prolonged diving.

It has been generally known for a considerable time that there is lengthy and complete inhibition of the respiratory movements in these birds every time the head, or even the beak only, is plunged into water, and that this occurs even if it is made possible for them to breathe freely by means of the insertion of a tube communicating with the air. Generally the inhibition remains complete during the whole time that the head of the bird remains under water. This period may be very long, and in any case much longer than would be enough to kill by asphyxia animals of approximately equal weight but with different habits of life.

ARTOM has made many experiments with ducks and other birds (*a*) with the vagus nerve intact, (*b*) after double vagatomy and in the following conditions :—

1) Normal conditions.
2) Extension or dorsal flexion of the neck.
3) Submersion of the head.
4) Submersion of the head and continuous supply of pure air, these two artifices being practised conjointly.

Conclusion :— The relations between the rhythm of respiration and the rhythm of the heart seem capable of satisfactory explanation by the hypothesis of the action of CO_2 of the blood on the cardiac inhibitory centres ; with more considerable doses of this gas, direct action on the muscle of the heart probably occurs secondarily. The mechanism of these relations between the heart and respiration is probably identical in diving and non-diving birds ; however fairly marked differences, but bearing almost exclusively on respiratory inhibition, exist between these two groups of very closely allied zoological species endowed with different habits of life.

At the end of his very interesting paper ARTOM gives 23 references to literature on this subject. B. J. C. te H.

The Effect of Feeding *Bacillus acidophilus*, Lactose, Dry Skim Milk or Whole Milk on the Hydrogen Ion Concentration of the Contents of the Caecum of Chickens.

BEACH J. R. *Hilgardia, a Journal of Agricultural Science,* p. 146. Berkeley, California, October 1925.

These experiments were undertaken to determine in what matter, if any, the hydrogen ion concentration of the caecal contents of chicks

would be influenced by feeding them with milk or certain milk products and the relation of any changes found to occur to the control of coccidiosis.

The studies have been confined to the caecum because coccidial infection of chicks is usually confined to this part of the intestinal tract.

The pH of the caecal contents of chickens was changed from the normal range of 6.0 to 7.4 to a range of 4.4 to 5.6 by feeding sufficient amounts of whole sweet milk, milk cultures of B. *acidophilus*, milk cultures of B. *acidophilus* plus lactose, lactose alone or dry skim milk.

The change in the hydrogen ion concentration of caecal contents from a single feeding of a milk product occurred within two hours to two hours and a half after the feeding and returned to normal within 8 to 24 hours after the feeding. B. J. C. te H.

The Influence of Feeding Lactose or Dry Skim Milk on Artificial Infection of Chicks with *Eimeria avium*.

BEACH J. R. and DAVIS D. E. *Hilgardia, a Journal of Agricultural Science*, p. 167, Berkeley, California, October 1925.

In these experiments it was attempted to combat artificially-produced coccidial infection in chicks by feeding them with sufficient lactose or dry skim milk to change the hydrogen ion concentration of the caecum from the normal range of 6,0 — 7.4 to a range of 4.4 — 5.6.

The results were uniform in demonstrating that a considerable degree of a protection against coccidial infection was gained when a sufficient amount of lactose or dry skim milk was added to the diet of chickens.

B. J. C. te H.

A New Tape-Worm of the Hen, *Raillietina (Davainea) grobbeni* n. sp.

BÖHM L. K. (Vienna). *Zeitschrift für wissensch. Zoologie*, Vol. 125, p. 519. Leipzig, 1925.

In the small intestine of a hen, which it had penetrated for some unknown reason, were found 10 chains (with their heads) and broken pieces of an 11th. chain of a tape-worm of the species *Davainea*. Further, by microscopical examination of the intestine, peculiar, nearly conical bodies were found of about ¼ mm. diameter, which on closer examination appeared as eggshell like forms. As no account has yet appeared of such forms in connection with tape-worms, BÖHM proceeds to describe them. With this object, he first attempted their classification, and found it had to be a case of a new species.

As a result of the extraordinary thickness of the cuticle with this species and of the strongly developed muscular system along the parenchyma the preparations *in toto* — even with careful squeezing — only gave an unsatisfactory view of the internal organisation of the proglottis. BÖHM therefore made use of a method which consists in first with the aid of the microtome, removing one cuticle (dorsal or central) of the pro-

glottis which was stained previously to embedding and then cutting away the other cuticle. These preparations combine the advantages of the preparations *in toto* and of the fine sections. BÖHM calls them " Halbtotopräparate ". He describes the external marks and anatomy of the work quite exactly, and gives very clear drawings.

Conclusion : On the basis of the relations of the cirrus vessel and the egg capsules, the worm is to be classed in the branch species *Raillietina* of the species *Davainea* Blanch, rich in varieties, established by FUHRMANN (1920), within that of the sub-species *Ransomia*, also established by FUHRMANN (1920).

He chose the specific name (*grobbeni*) in honour of his teacher, Prof. Dr. K. GROBBEN of Vienna. B. J. C. te H.

Artificial Lighting of Poultry Houses.

BROWN E. T. *Journal of Ministry of Agriculture*. p. 716. London, November, 1925.

The object of lighting is to increase the rate of production at a time of year when the retail price of eggs is high. The results fully justify the initial expense of installing lights in the sheds and the slight extra amount of labour entailed in attending to the birds after dark.

M. BROWN comes to the following conclusions :

(1) The effect of lighting the house is to increase the output of eggs during the winter, as the average number of eggs laid by the test flock during the first 12 weeks was 61 $\frac{1}{4}$, as against 34 $^3/_4$ laid by the control flock.

(2) The annual production is only slightly increased, in this case by 12 $\frac{1}{4}$ eggs per bird.

(3) The cost of the additional food amounted to 6 $\frac{1}{4}$ d. for the year, whereas the increase in egg value was 5 s., 1 $^3/_4$ d. per bird ; an increase in gross returns which is more than sufficient to pay for the extra cost of labour and lighting. B. J. C. te H.

Bacillary White Diarrhoea of Chicks.

DOYLE T. M. *Journal of Comparative Pathology and Therapeutics*. Vol. XXXVIII, part 4, p. 266. Edinburgh, 1925.

Bacillary white diarrhoea is essentially a disease of artificial incubation. It may also occur on farms where only natural methods of hatching are employed, but in such cases it rarely causes any trouble and tends to disappear.

This is partly due to the dark, warm atmosphere of the incubator being favourable for the survival of the causal parasite, while, under natural conditions, the light and temperature have an inhibitory effect and rapidly bring about its death.

As hen-hatched chicks also are continually on the move, the infection is disseminated over a wide area and the same conditions do not occur as in a crowded brooder house. The fowl is the only species susceptible to

natural infection. Many chicks which survive the disease harbour the parasite in one or more of their organs throughout life.

Morphology, Cultural Characters, Pathogenicity etc. are described.

The gas-producing powers of *B. pullorum* are of a fluctuating character and there does not appear to be any reasonable grounds for distinguishing two groups, as has been suggested by HADLEY (1).

The agglutination test. A point of practical importance is that reacting birds always have infection of the ovary; other organs may also be infected. This conclusion is based on the results obtained from the bacteriological examination of a considerable number of reactors.

In America agglutination in a dilution of 1:33 is considered to signify infection, and in England in a dilution of 1:50. DOYLE, as the result of work, recently carried out, now regards complete agglutination in a dilution of 1:25 as a positive reaction.

DOYLE has tested the method of BEAUDETTE, but in no case has found any trace of agglutination with the albumen of eggs from carriers. The yolks of some of these eggs were proved to be infected with *B. pullorum*. The method therefore appears to be valueless.

It is known that the *B. pullorum* and the *B. sanguinarium* cannot be differentiated by serological methods. A positive reaction to the test will signify, therefore, infection by either of these organisms.

The organism is not a normal inhabitant of the healthy chick. The fact that many chicks which recover, harbour the causal agent and are the potential source of future outbreaks, is a strong argument against the policy of treatment.

B. J. C. te H.

Eye Nematode in Chickens.

HOK L. *Petaluma Poultry Journal*, No. 2. Ling Nan Agricultural Manufacturing Company, Petaluma, California, 1926.

The eyes of some pullets became badly swollen. Some died. In the opaque, whitish fluid around the eyeball were found small thread-like organisms. On microscopic examination it was found to be a member of the Nematoda, very likely *Filaria mansoni*, described by Sir Patrick MANSON in Hongkong.

The larvae of the *Filaria* grow to about 300 micrometers and live in the blood septem of the host. The adults are slender nematodes from one-tenth of an inch to a few inches in length. They can be transmitted from one host to another through the agency of the members of the Culicidae or the mosquitoes. The Chinese saying: "A mosquitobite causes the blindness of chickens" may have truth in it.

B. J. C. te H.

(1) As far as Holland is concerned I fully agree with HADLEY, as I have never seen a non gas-producing strain change into a gas-producing one. — B. J. C. te H.

Poultry Farming and Egg Production in Denmark.

KOCK W. A. Publishers Dyva and Jeppesen. Copenhagen, 1925.

The difficulties which beset Danish agriculture in the eighties of last century as a consequence of foreign competition and falling prices made many Danes anxious to find new sources of income. One of the most important of the subsidiary activities that were taken up was poultry keeping, with a view to egg production. Now, on many farms, poultry keeping constitutes one of the principal sources of income.

The introduction of Mediterranean breeds has had a great and beneficial influence on the numerical output of eggs in Denmark and also on the size of the eggs themselves. Together with Plymouth Rocks, Wyandottes and Rhode Island Reds introduced from America, the Mediterranean breeds of fowls are certainly among those most widely spread throughout Denmark. In 1888 the number of hens, cocks and chickens was 4.5 millions; in 1924, 21.3 millions. Little attention is paid to fattening, while systematic duck breeding is practically unknown in Denmark. There are only a few turkey breeders, but the breeding of geese is of some importance.

Eggs were exported to England by the regular steam route for the first time in 1865. In 1924 the egg export was third on the list of agricultural products, and amounted to 41.6 million score with a value of 150.8 million Kroner.

In 1895 the Danish Cooperative Egg Export Society was started. The great advantage of this excellent organisation is that it has established the collection and stamping of eggs. Each egg is stamped with a number indicating the producer, which makes it possible to immediately identify suppliers of eggs of inferior quality. The local branches of the society all have their own egg collecters, who make a tour of the members at regular intervals. All eggs are stamped with the trade mark of the Society. They are exported at once, the object of the Society being to furnish foreign markets with only the very best possible newlaid Danish eggs.

One of the most effective means towards development of poultry farming has proved to be the competitions for the best kept and most profitable stocks of fowl belonging to individual members, the aim being to promote poultry breeding on strictly economic lines, no regard being paid to the purely show aspect. From the breeding centres cheap eggs are also distributed for hatching.

The Danish Poultry Breeders Union extends over the whole country. It promotes poultry farming by holding poultry breeding courses, egg-laying competitions, poultry exhibitions; it establishes control stations, issues a monthly paper and gives advice to poultry farmers.

B. J. C. te H.

The Breeding Diseases of Poultry, and their Control, with Special Reference to Tuberculosis.

LERCHE M. *Deutsche tierärztliche Wochenschrift*, No. 48, p. 840 Breslau, 1925.

The aim of the German farming industry is to become gradually independent of imported supplies of eggs and table fowls. Poultry

breeding has on this account become of great importance in the post-war years.

Several diseases are described.

Diseases like dysentery the causes of which are various ; infections with *bact. coli.*

Within the paratyphus group are named :

1. *Bact. pullorum*, which serologically is near to the Piper poultry typhus, but bio-chemically is different from it.

2. *Bact. typhi gallinarum alcalifaciens* Pfeiler or *Bact. sanguinarium* Klein. As a rule it occurs in fully grown poultry. LERCHE, however, found it in 7 farms as a special disease of young fowls.

3. Paratyphus of water fowls, hitherto described as paratyphus B. Vaccine inoculation against these diseases has proved good. Sera must not be inserted with carbolic acid, because with quite young chickens poisoning has been observed. The State Serum Institute, Rotterdam, considers a special serum necessary. With these infections it is useful to substitute whey for the drinking water.

UHLHORN carried out a series of transmission tests on chickens with *Eimeria stidae* of rabbits, which gave surprising results. The chickens were infected, but only showed transitory symptoms of disease, and recovered again, whereas with poultry cultures, infected chickens died after 3-5 days.

The poultry brood suffers most from tuberculosis. All breeders should regularly have their fowls examined for tuberculosis by means of the intra-cutaneous tuberculosis test. The tuberculous reaction is 1-11 days after a positive injection, even though diseased processes cannot be microscopically recognised on the organs. A favourable influence can be effected by cold-blooded tubercle bacilli. Specially noticeable is the early revival of laying capacity. What this action depends on is not at all clear ; it does not appear to be a specific albuminous action. Warning must be given against indiscriminate inoculation with Friedmann inoculating matter without segregating the diseased, fowls since with this treatment only subjects immune to bacteria remain alive.

The Poison of Fowls and Vacccine Pock Marks.

VAN NEDERVEEN H. J. Volgelpok en Vaccinevirus. *Tydschrift voor Diergeneeskeende*, Vol. 53, p. 63. The Hague, 1926.

After the passage of fowl pock virus, emanating from a diseased hen through rabbits and calf, characteristic pock marks were produced on the arm of a child ; these pustules were quite similar to vaccine pock marks.

After these passages, the virus, together with those acquired, had fully maintained the original qualities : Introvenous incorporation of the modified virus in the susceptible hen always resulted in the disease of fowl pock (formation of diphtheritic mouth membrane).

On the basis of his experiments, the author concludes that there is an intimate relationship between the two viruses.

B. J. C. te H.

Avian Tuberculosis in Mammals.

PLUM N. *Publication of the Serum Laboratory of the R. Veterinary and Agricultural High School Copenhagen.* Printed by Kundrup & Wunsch, 1925.

A very thorough study on the above problem, containing exhaustive bibliography. Pages 67-100 deal with previously described cases of spontaneous avian tuberculosis in mammals (human beings, horses, cattle, pigs, and various small animals). In summing up this section, PLUM says: Avian tuberculosis in pigs has been so minutely investigated, that its significance for this animal can be considered to be cleared up. The significance of this infliction for mankind will be greatly elucidated in a future not too remote. Systematic studies with regard to the horse have been made.

A defect is that in most experiments mammals only have been used and hardly ever hens at the same time.

Mammals are in general infected by ingestion of faeces containing bacilli, or by eating the carcases of fowls.

With man there is always the possibility that he can be infected by eating eggs containing bacilli, for it is proved that the eggs of tuberculous hens can contain bacilli, which are not killed by the usual light boiling. Pages 100-121 describe cases of experimental avian tuberculosis, namely, with porpoises, rabbits, dogs, monkeys, mice, rats, pigs, and various other animals.

The results may be summarised as follows :—

(1) Subcutaneously injected avian tubercle bacilli are only capable of producing local reactions.

(2) Intraperitoneally inoculated avian tubercle bacilli were capable of causing tuberculosis in certain animals, but not in others. With all animals, large doses of not very virulent material are, on account of the toxic action of the bacilli, capable of causing death accompanied by cachetic symptoms, with atrophy of the organs. With all animals death can be caused with symptoms of type Yersin.

(3) In young animals, avian tubercle bacilli of great virulence appear as a result of ingestion of feeds.

Pages 126-174 describe particular investigations of PLUM. The following remarks appear in the summary :—

Whilst formerly the possibility of avian tuberculosis in children was not taken into account it is now proved that children may be infected spontaneously with ornitho-tuberculosis. Comparatively many of those animals which react to avian tuberculosis have aborted. The pregnant uterus appears therefore to be a place sought eagerly by the ornitho-tubercle bacilli. Animals which abort on account of avian tuberculosis are either not attacked in any other place, or the demonstrable alterations, which take place preferably in the lymphatic glands of the alimentary canal, are very slight. When the avian tubercle bacilli have attacked the uterus, they are able to cause abortion. The bacilli subse uently maintain life in the abscesses which form under the

mucous membrane of the uterus, and so later abortion can again take place.

The only rational method for control of avian tuberculosis is to keep in view the source of infection itself, namely, the poultry. Hitherto avian tuberculosis has been allowed to gain ground amongst poultry, in a manner completely foreign to the general conditions of care of farm stock in Denmark.

B. J. C. te H.

Investigations concerning Para-typhus Germs of Vertigo in Carrier Pigeons.

RICHTER E. *Zeitschrift für Veterinärkunde*, No. 12, December 1925.

Giddiness or vertigo causes heavy losses in pigeon farms. Generally speaking, only pigeons of 4-10 weeks fall sick. Subdural abscesses are found in the large and small brain. Bacteriological culture treatment gave a bacterium of paratyphus group B in pure culture.

RICHTER describes the morphology, biology etc. of the bacterium. Various experiments were made with mice and pigeons, all the bacterial cultures showed themselves in food tests as mouse-pathogenic, and those taken are to be considered as specific pigeon cultivations.

In the summary RICHTER says:

" According to the results of the pigeon infection tests, these bacteria represnt only concomitants of the unknown stimulus causing vertigo or staggers ".

B. J. C. te H.

General Information.

Request for co-operation in the Proceedings. — M. B. I. C. te HENNEPE editor of the Proceedings of the International Association of Poultry Instructors and Investigators, invites all who are interested from a scientific point of view in avicultural questions, even if not members of the above Association, to co-operate in its work by forwarding reports, publications, pamphlets, books, etc. which deal with this important branch of international agricultural economy.

The reception which these proceedings have met with incompetent scientific circles has been very favourable. Mr. A. JULL, Poultry Husbandman of the Bureau of Animal Industry, U. S. Department of Agriculture, wrote recently to M. B. I. C. te HENNEPE: " It is with great pleasure that I have learnt that you are accepting the proposal made by the International Association of Poultry Instructors and Investigators to prepare reports on aviculture for publication in the *International Review of the Science and Practice of Agriculture*. The appearance of the " Review " will be followed with the greatest interest ".

It is requested that all communications in regard to the editing of the Proceedings of the International Association of Poultry Instructors and Investigators be addressed to M. B. I. C. te HENNEPE, Diergaardesingel, 96 A, Rotterdam.

AGRICULTURAL INTELLIGENCE

GENERAL AGRONOMY

Agricultural Meteorology.

147. **Research on Drought in Russia.**

I. — DANILOFF Prof. L., Posoukhy na Ukraini, ikhnia Klimatologia ta synoptika :— *Visnik Silsko-Gospodarskoi Nauki*, P. III, vypusk 10-12 Str. 1-7, Buro Silsko — Gospod. Naukovogo Komitetu Ukraini. Kkarkiv-Kiiw, 1924 (Droughts in Ukraina, climatological and synoptic research). *Messenger of Agricultural Science*, Vol. III, Nos. 10-12, pp. 1-7, Agricultural Bureau of the Scientific Committee of Ukraina, Kharkow-Kiew, 1924.

II. — ROTMISTROFF Prof. B., Posukka ta borotba sneiu (Drought and its control). *Ibidem*, pp. 11-17, Kharkow-Kiew, 1924.

III. — KOLKUNOFF Prof. V. Rolia selekzii v borotbé s posukhoiu. (The role of selection in the control of drought). *Ibidem*, pp. 7-11.

IV. — OPOKIV Prof. K., Meliorazia iak zasib borotbi s posukhoiu. (Land improvement as a means of control of drought). *Ibidem*, pp. 18-22.

V. — LEBEDEFF Prof. A., Nabliudenia nad raskhodom vody potchvoiu pod aprelskim parom iarovoi pchenitzei i kukuruzy u Donskoi Cblasti. — *Izvestia po Opytnomu Delu Dona i Severnago Kavkaza* (Trudy Selskokhoziaistvennykh opytnykh utchrejdenii), vypusk 4, str. 108-134, Rostoff na Donu, 1924 (Observations on the absorption of soil moisture in fallow land and in land sown with spring wheat and maize in the region of the Don). *Annals of Experimental Agriculture for the Don and the Northern Caucasus*. (Work of Agricultural Experiment Institutions), Vol. 4, pp. 108-134, Rostoff on Don, 1924.

VI. — VIAZOVSKY P., Rol rastitelnogo pokrova v raspredelenii temperatur i vlajnosti v nijnikh sloiakh vozdukha 1924. (The effect of a covering of plants in the distribution of temperature and humidity in the lower strata of the air). *Ibidem*, pp. 134-150. Rostoff on Don, 1924.

VII. — IVANOFF L. Sovremennoe sostoianie voprossa o zasukhoustoïtchivosti rastenii. — *Trudy po prikladoi Botanike i Selekzii*, Vol. 13, No. 1, p. 3-32, 1922-1923. (Gosudarstvennyi Institut Opytnoi Agronomii). Leningrad, 1923. (Present position of the question of plant resistance to drought), *Bulletin of Applied Botany and Selection*, Vol. 13, No. 1, pp. 3-35, 1922-1923 (Government Institute of Experimental Agriculture. Leningrad, 1923).

VIII. — MOLIBOGA A., O sostoianii selsko-khoziastvennoi meteorologicheskoi sieti buro selsko-khoziastevennoi meteorologii Gesudarotvennago Instituta Opytnoi Agronomii po materialam sobrannym buro za 25 liet ego

deiatelnosti — *Isvestia Gosudarstvennago Instituta Opytnoi Agronomii*, P. II, No. 1-2, tr. 33-36, Leningrad, 1924. (The System of stations organised by the Bureau of Agricultural Meteorology of the Government Institute of Experimental Agronomy, and data collected by the Bureau during the past 25 years).

IX. — MAKSIMOFF N. O programmakh i metodakh izutchenia zavisimosti rastenii ot meteorologicheskikh faktorow.. (Scheme and methods for the investigation of influence of meteorological factors on plants). *Ibidem* pp, 34-40, Leningrad, 1924

The terrible calamity, caused by the disastrous harvest of 1921 in Russia, has aroused interest in the investigation of the causes which occasioned it. Deficient harvests, sometimes entailing scarcity, are unfortunately a well known phenomenon which recurs periodically in Russia at longer or shorter intervals. They are always brought about by drought which is more severe in the wide plains of South-East European Russia, a region pre-eminently wheat-producing. The drought and disastrous harvest of 1921 were therefore neither the first nor the worst which have afflicted Russian agriculture. The same phenomenon occurred in 1892, with much greater intensity. But never yet, before 1921, had the disaster amounted to a national calamity destroying, by famine and the disease which ensued, millions of human lives. Never before had Russia been obliged to have recourse to relief largely and generously organised by foreign countriee. to check the ravages of the scourge which had fallen upon her. The reason of this was that formerly agriculture was in a normal condition and that an organisation existed for the control of scarcity ; there was on one hand a vast system of reserves of wheat, which were renewed every year, while the reserve of the previous year was placed upon the market: there was a special reserve fund in cash, which was drawn upon to cover the expenditure on relief to be distributed in the districts suffering from food scarcity ; there was, lastly, the system of means of communication, which worked normally and enabled a supply of wheat to be brought in good time to the distressed districts. In fact Russia is so large, and climatic conditions are so diverse from one district to another of its territory, that the harvest can scarcely ever be deficient in all regions of production. It was at most, in exceptional cases, necessary to check or suspend for a time the export of wheat to foreign countries in order to meet the requirements of the famine-stricken districts.

This was no longer the case in 1921. Agriculture was exhausted and reduced to a condition of helplessness until then unknown. Reserves of wheat and capital no longer existed and the system of means of communication was totally inadequate. But the original cause of the calamity of the year 1921 was certainly drought, as it had always been in former years of bad harvests. Research on drought, its influence and means of controlling this scourge has therefore enormous importance for Russia, a country pre-eminently agricultural where all economic life depends always on the results of the harvest. Such research is also important for the other countries of Europe, on whose markets Russian wheat, sooner

or later, must again take the place which it formerly held. Also, it is of great interest to world agriculture, for drought, accompanied by deficient harvests, is also experienced in many agricultural regions. The observations, considerations and deductions of the Russian savants, whose names are given in the indication of the sources which have been made use of in compiling the present article, deserve therefore the whole-hearted attention of agricultural circles.

The Soviet Republic of Ukraina having suffered most from drought in 1921 and the production of wheat being very important for this country, the work of its savants was directed to research on this question. A complete number of the *Messenger of Agricultural Science*, published by the Committee of Scientific Agriculture of Ukraina, is given up to the subject. Besides the four original articles by Professors DANILOFF, ROTMISTROFF, KOLKUNOFF, and OPOIKIV, which are here reviewed, the number contains a series of reviews of the works of other Russian and foreign scientists on the question of drought.

The articles by the four authors just mentioned are distinguished from the other Russian papers by their decisive character. Working under the impulse of the urgent necessity of finding means of defence against an ever threatening calamity, they were led by their conclusions to recommend practical remedies. In the region of the Don and in the northern Caucasus drought is often still more disastrous than in Ukraine. Only two papers, by Professor LEBEDEFF and VIAZOVSKY, are available relating to that region. Both have a specialised character, are studies of local conditions and do not recommend means of control.

The largest and most dispassionately scientific paper is that by Prof. IVANOFF, published in the *Bulletin of Applied Botany and Selection* of the Institute of Experimental Agriculture at Petrograd. A critical analysis is given of the information on the resistance of plants to drought ; no remedy is found for drought, but the author indicates the existing lacunae in the question and all obscure points which have still to be cleared up before practical measures can be recommended for the control of this scourge. Finally Messrs. MOLIBOGA and MAKSIMOFF, also of Petrograd, give a brief account of agricultural meteorology in Russia, its methods of work and the results obtained by its work during the past 25 years.

I. The paper by Prof. DANILOFF is devoted to the study of drought in the Ukraine from a meteorological point of view.

The author begins by giving some general data on the rainfall in the Ukraine. The North-West part of the country is described, a region on the borders of White Russia and Poland (basins of the Pripet and the Desna), which has an average annual rainfall of from 600 to 650 mm., that is to say, a higher rainfall than the eastern part of the European plain. To the South and South-East of that region, up to the latitude of Orqueieff-Ekaterinoslav-Lougansk, an average annual rainfall of 500 mm. is registered. Descending still further towards the South, a region with an average rainfall of from 400 to 450 m.m. is found, while the zone of the littoral of the Black Sea has only 350 mm. The culti-

vation of cereals only requires an annual average of 200-400 mm., hence the rainfall of the whole country should be sufficient for these crops. In practice however it is proved that this conclusion is erroneous. The error lies in the fact that in most cases, it is not the average rainfall of the year which is important but its distribution in the course of the year. A large part of the rainfall falls in winter as snow, and two thirds at least of that water is lost by running off when the snow melts and cannot be made use of by the crops. Torrential rains also carry off a large quantity of water, which runs away on the surface and is not of advantage to the crops. The author estimates that at least half the annual rainfall is lost in this way.

The prolonged periods of drought however are still worse, during which there is absolutely no rainfall. These periods of drought are repeated regularly at intervals.

The author, distinguishes two periods of drought which recur regularly in Ukraine, one in spring — April-May — the other in autumn — August-September. More prolonged droughts which affect a whole season also recur regularly, but at intervals of several years. Generally, the duration of droughts is also prolonged during more than one consecutive year, that is to say that after a period of several years of abundant rainfall there generally follows a period of some consecutive years of more or less intense drought.

In seeking the reasons which determine these periodic droughts, the author notes the relation which exists between drought and meteorological phenomena, the distribution of cyclones and anticyclones. Drought always occurs in regions of high barometric pressure. All phenomena of high atmospheric pressure and all displacement of anticylclones are always accompanied by drought. Study of the path which displacements of anticyclones follow in their course, and the direction of that course, is therefore of very great importance, as it helps to determine the arrival of periods of drought and the period of their duration.

The following are the principal results of research undertaken by the author :— (1) Periods of drought of relatively short duration (not exceeding 12 to 15 days) occur as a consequence of a displacement of the maximum atmospheric pressure starting from a centre in the Iceland-Scandinavian region and travelling towards the South-East across Europe to the Caucasus. In its preliminary phase this phenomenon is accompanied by a sensible fall in temperature, especially at night, but afterwards it rises again ; the centre of maximum barometric pressure at that time reaches the meridian of the Dnieper.

This phenomenon occurs generally in spring and autumn. In summer, the centre of maximum atmospheric pressure lies much further South, although always with a tendency to displacement towards the East. It is in consequence of this situation that the tendency of the temperature to fall during the early days of the displacement is much less noticeable in summer.

In the more prolonged periods of drought, it is not the anticyclones which come from the West, but the atmospheric depressions which are

formed in Eastern Europe and even in Western Siberia which are most important. These depressions become stationary and push back the spheres of high pressure towards the South-West of the European plain. It is possibly a case of re-establishment of equilibrium between two centres of barometric waves which come into collision without co-ordination, one from the South-East of Europe and the other in the Lower basin of the Dnieper and on the shores of the Black Sea. The displacement of the region of high pressure, which is at the same time a region of drought, moves from the East westwards. The changes of temperature are not in this case so marked as in the former ; especially no fall in temperature is noticed during the first few days. These periods of drought generally occur in spring. Droughts of very long duration are accompanied by a displacement of the centres of high atmospheric pressure starting from the Atlantic towards Siberia with a widening of their base on the coasts of Scandinavia ; two centres of reduced pressure are thus formed — one in the northern part of the Atlantic, the other in the North-East of Europe. Consequently the isobaric lines of the centres of high pressure have the form of a triangle with curved sides, the centre of which is situated on the lower part of the Dnieper. Waves of depression pass over Europe one after another in an eastward direction ; in addition lesser waves descend from the North on Scandinavia. This phenomenon causes torrid droughts. The re-establishment of equilibrium causes a driving in of the centre of reduced pressure to the North-West of Europe and a break of continuity of the anticyclonic zone in the direction of the parallels of latitude, forming an outlet for the centre of high pressure westwards.

The duration of this phenomenon and the extent of its development give the impression that it is the result of atmospheric waves of very great amplitude, whose undulations are prolonged for several months. The observation of this phenomenon is one of the most recent advances of science in the field of weather forecasting. In this way the prediction of a threatening period of drought at a time more or less distant is therefore closely allied to the forecasting of weather more or less in advance.

Owing to the progress made in the study of meteorological conditions, together with the records of previous years, it may be hoped that the problem will be solved in such a way as to satisfy the exigencies of practical agriculture.

II. Prof. ROTMISTROFF deals mainly with farming processes which may be useful in the control of drought.

Formerly, care was taken in Russia, to accumulate snow in the fields during winter, to obtain the benefit of the moisture afterwards from its melting. Means had been devised for leaving in the fields the stalks of tall stiff plants, such as sunflower, sufficiently spaced to retain a large quantity of snow, to avoid its removal by wind and to slow down its melting in spring, in order that the soil might absorb a greater amount of water. Partial re-afforesting of the steppe was also recommended again with the object of forming a wind-break and of preserving the humidity of the air if not that of the soil in the neighbouring cultivated fields. The

snow on cultivated fields was also covered with ashes to cause a rapid melting and the absorption of the water on the spot, the snow which remained preventing the running off of the water along the surface. Snow was also accumulated in trenches between the ridges.

All these methods have been found insufficient, or even quite illusory, and have not proved of practical application.

It has since been proved that the water always runs off at the surface so long as the ground is frozen, that is to say so long as it is covered with snow, and that it is only after the melting of the snow that it can infiltrate and be stored in the ground. Consequently it is the autumn rains which are most important from the point of view of the water utilizable for agriculture. The autumn rain infiltrated in the soil remains there, for it is held in the soil by frost. The winter snow gives no increase of humidity ; it loses by evaporation and by running off on the surface when melting, and the field has not generally in spring more than the same degree of humidity that it had in autumn. It is necessary therefore in the control of drought to utilise as much as possible of the humidity of the soil, by avoiding its useless waste and by attracting to the vegetable soil the reserves of moisture which lie in the sub-soil. In studying the records of soil humidity collected during a period of 25 years, from 1887 to 1912, in the experimental fields of the Odessa agricultural station, the author reaches the following conclusions:

The Odessa region is often subject to drought, the average annual rainfall not exceeding 320 mm. It has been calculated that 1 mm. of rainfall corresponds to 450 *pouds* of water per *dessiatine*, and that to form 1 *poud.* of dry vegetable matter, 400 *pouds* of water are required; a rainfall of 1 mm. suffices therefore for the formation of 1.5 *pouds* of grain and straw, and a rainfall of 320 mm. could give 480 *pouds* of dry matter per *dessiatine*, which according to ordinary calculations corresponds to a crop of 140 *pouds* of grain and 320 *pouds* of straw per *dessiatine* (about 25 q. of grain and 529 q. of straw per ha.). Now it is evident that these results would give an immense crop for Russia. But in this calculation the inevitable losses of water have not been taken into account. There are firstly the showers of short duration which only affect the surface of the soil, there are next the torrential rains part of which is lost by running off at the surface ; lastly there is the snow, which does not enter into account for agriculture. The author estimates that on the average only about 200 mm., out of the annual 320 mm., are profitable for agriculture. This quantity of water would still allow for a crop of about 100 *pouds* of grain and 200 *pouds* of straw per *dessiatine* (16 q. of grain and 32 q. of straw per ha.), which would still be a very satisfactory yield. It is considered that a quarter of that quantity still constitutes a satisfactory crop for years of drought. The evident conclusion is that a large quantity of the moisture available for agriculture in generally lost.

It is this loss of moisture not utilised by agriculture that the author mainly wishes to avoid, and it is in agricultural methods designed for this object that he sees the most effective means for counteracting drought. In his opinion, the run off of water during the heavy autumn

rains must be checked. In order that the rain may be rapidly absorbed by the soil, the upper layers should be well broken up to a depth of about 5 to 10 cm. The surface of the field should not, however, be perfectly flat and level, so that the stratum of air which is in immediate contact with the ground may not be constantly displaced and renewed by wind, which would dry up the soil. The most advantageous agricultural method is that which leaves the surface of the ground covered with small clods the size of a pigeon's egg. The clods themselves will dry up very quickly, but they check the circulation of the air between them and, to that extent, prevent the drying of the soil between and beneath the clods.

Surface tillage carried out with light instruments, cultivators, weeders, hoes and harrows should be repeated very often. It should be begun immediately after the harvest, the stubble being first pulled up which starts evaporation by drawing the moisture to the surface and by increasing the evaporation area. It has been observed that if the stubble remained standing the soil would become perfectly dry in from 8 to 10 days after heavy rain of 12 to 15 mm. In carrying out the work the stubble should merely be uprooted, without turning over the layer containing the roots, or a still greater drying up of the whole layer would result; it is not therefore a matter of burying the stubbles but only of uprooting them as they are removed with a harrow subsequently. Surface tillage should be repeated about every fortnight to maintain the upper layer of the soil in the desired condition. The author considers that this procedure would, in most cases, save a large quantity of moisture which would otherwise be lost, and that it will also be effective in the control of drought.

III. Prof. KOLKUNOFF, considers that the best safeguard would be found in the selection of xerophilous types of cultivated plants. It is not that he does not fully recognise the importance of tillage methods, but considers that this side of the question has already been very fully studied, while hitherto little has been done respecting the types of cultivated plants most resistant to drought. He finally recommends a suitable rotation of crops and a system of cultivation. It is doubful whether the deficiency of moisture in the soil is the only cause of low yields in times of drought. If this doubt is well founded, it is evident that means devised for accumulating moisture in the soil do not sufficiently safeguard against drought. Hence it is not sufficient to rely on cultivation methods which can only regulate the amount of water in the soil.

The author first of all investigated the peculiar properties of plants resistant to drought, and the indications by which they can be recognised. It is generally thought that the most essential property of such plants is a well developed root system; deeply penetrating tap-roots are no doubt able to imbibe moisture from the lower strata of the soil. However, this property is not alone sufficient, as the soil may contain enough moisture and yet the plant may none the less suffer from drought in certain conditions as proved by experiments. The plant will suffer from drought as soon as the amount of moisture transpired by the leaves exceeds the amount supplied by the roots. The writer terms this "physiological drought". The ligneous vessels of the plant can only conduct a certain

quantity of water to the leaves. Water must therefore be accumulated in the soil but it is still more necessary to prevent excessive evaporation from the plant itself. There are two means of effecting this object. The humidity of the air may be maintained and re-afforestation has always been recommended for this purpose; but this measure is neither very certain in its effects, nor easy to put into practice, as it requires heavy expenditure and much time. The second means is to find or select types of plants which transpire as little as possible.

It has been observed that plants of winter growth are generally more resistant to drought than those of spring; they are also able to stand cold better and the attacks of insects.

The problem therefore is as follows: — We must, by selection, create types which transpire little moisture, have deep roots, can be grown in winter, and are very resistant to cold and pests.

As regards methods of procedure, the author indicates three: —

(1) the selection of individuals suitable for creating pure lines;
(2) importation of foreign plants;
(3) the creation of new types.

The method of importation of foreign plants is eliminated as it has been tried for wheat and has given unsatisfactory results; the imported wheats very soon lost their essential qualities, and only gave a much lower yield than indigenous wheat.

The indications of resistance to drought which may serve to give direction to research on selection and the creation of new types are: —

(*a*) The development of the root system.
(*b*) The intensity of transpiration by the leaves.
(*c*) The resistance of the plant to drying up of the vegetable tissues.

The last category, however, is at once discarded, since no plant resists drying up without prejudice to its yield. As regards development of the roots, it is curious that plants which have the most largely developed root system are precisely those which are least resistant to drought; this is explained by the intervention of the factor "physiological drought" mentioned above. As a matter of fact the intensity of transpiration is very great in the leaves of these plants, and their growth would only result in impoverishing the lower stratus of the soil by consuming the reserves of moisture.

Selection therefore can only be directed to the intensity of transpiration by the leaves. Recent research by the author and his collaborators has shown that the intensity of transpiration does not depend on the size, nor on the number of the stomata, nor on the diameter of their ostioles, but exclusively on the size of the cells in all tissues of the plant. This is explained by the fact that the rate of passage of water through the cells, and therefore through the vessels, must necessarily depend on the size of the cells. There are great differences in plants as regards the size of the cells, not only between different varieties or types, but even between individuals of the same type. The author even considers that it is possible to find in this character a sufficiently great diversity for form-

ing a whole " biological scale ", and thinks it possible to create new lines on the basis of this character. He has crossed a type of wheat with broad leaves and medium sized cells thus ensuring vigorous growth in the new plant, with another type having narrow leaves and small cells. The result has been the creation of a new type of winter wheat resistant to drought, and which has already reached the F_4 generation. It is on these lines that he would wish to direct further scientific research and large-scale experiments in the practice of agriculture, by extending the field of these researches to all species of cultivated plants.

The author then discusses the rotation of crops, and considers that cereals with deeply penetrating roots exhaust to a great extent the reserves of moisture in the lower strata of the soil and hence a great decrease in the number of bacteria in these strata is brought about which renders the soil infertile. Cereals should therefore never be sown for two successive years on the same field, as is generally done with the triennial rotation (fallow, winter cereals, spring cereals). On the contrary, plants with a differently arranged root system, with spreading surface roots, should be introduced into the rotation. Leguminous plants and root crops satisfy these conditions. They transpire less moisture, and hence, leave a large reserve in the lower strata of the soil and thus favour the development of bacteria. The rotation of cereals with plants having more widely spreading and more superficial roots is especially important during years of drought. Hoed crops have the further advantage that they are well suited to cultivation in lines sufficiently far apart for a horse to pass between, which enables the field to be cultivated every fortnight (indispensable in years of drought).

The author therefore recommends replacing the present triennial rotation — fallow in pasture, winter wheat, spring cereals — by a five year rotation as follows : — (1) Winter wheat. (2) Late hoed crops (potatoes). (3) Spring cereals. (4) Late hoed crops (mangolds, carrots). (5) Early hoed crops (peas, beans, flax). With this rotation, cereals would always come after hoed crops which accumulate reserves of moisture in the deep strata. It is seen therefore, that the author recommends for the control of drought methods which involve a change of rotation, the removal of stubble and weeds, frequently repeated surface tillage and, lastly, the creation of types of plants resistant to drought.

IV. M. Opokiv, values very lightly all those measures which have only a palliative character. The accumulation of reserves of moisture in the soil and sub-soil on one hand, and economy in its consumption by means of diminished evaporation on the other, may help to obtain a fair crop of winter wheat in season of drought, but could never ensure a good yield when the rainfall is insufficient and, as for spring crops, all these measures remain powerless to make them profitable. In fact, all processes of dry farming become useless at a certain point when the air and the soil become heated, in a season of drought, up to 60°C. In such a case the growth of whole fields has been seen to wither and perish in two or three days and then only an abundant rainfall could have saved the crops. Heat keeps pace with drought when anticyclones

occur, and even during ordinary seasons less intense and less prolonged periods of drought may exercise a disastrous influence on the crop, if they occur at such times in the growth of the plants when the need of moisture is more strongly felt. Prof. BROOUNOFF has very well named these times "critical periods" of growth, from a meteorological point of view. These critical periods are generally seed time and subsequently periods when vegetative growth is most intense. Plants therefore need certain definite quantities of moisture, available at different phases of their development, and to obtain a good crop, that moisture is absolutely essential.

The writer sees only one effective remedy against drought, whether prolonged or temporary, namely irrigation. In order that the best results may be obtained from irrigation the water must be supplied to the plants in the form to which they are accustomed, that is in the form of an artificial rainfall.

Experiments of mechanical watering have shown that, even in normal seasons a surplus yield of from 100 to 200 % is obtained with this method for the principal crops, owing to the suitable distribution of the water supplied to the plants, the phase of growth through which they are passing being taken into account. The only objection which can be raised to this method is the heavy expense involved and the quantity of water which must be available. But the Ukraine has a sufficient number of rivers, springs and wells to provide for this requirement. The same rivers could also supply the power necessary for a system of electric stations sufficient for the distribution of the water required for agriculture. The cost of constructing such a system to supply the hydraulic requirements of the country would be enormous, but not beyond the financial resources of the State, and the expenditure would soon be repaid with full interest, owing to the additional yield of all crops.

The author thus returns to the great projects of electrification of the country, much discussed in Russia five years ago and which naturally have never been realised on account of their very magnitude.

V. The paper by Prof. LEBEDEFF, relates exclusively to conditions of growth in the Don region. The normal climate of that region is described as particularly unfavourable for the growth of cereals, especially for spring cereals. In fact, in the steppes of the Don the heaviest rainfall occurs during the months of June and July, while the spring season is generally very dry. Spring wheats have not therefore the amount of moisture which they require at the commencement of their growth, while the summer rains often hinder the harvest and damage the crop. Nor are these rains of use for the subsequent sowings, since the humidity is not retained long enough in the soil, and the months of August and September are always dry. The farmers endeavour to avoid this drawback by giving preference in spring to the planting of late plants, such as sunflowers, maize, mangolds, which can benefit by the summer rains and which are harvested in August and September.

The author carried out a series of experiments in order to ascertain the varying losses of moisture by the soil as consequent on the

rotation most commonly used in the country, namely: — fallow, winter wheat, barley, maize, spring wheat, barley. He has measured periodically the moisture of the soil in each layer of 0.5 cm., down to a depth of 2.5 m. and separately for each field of the rotation indicated. To determine the degree of moisture of the soil, the samples were dried at a temperature of 105-110°C. by means of a current of air, until the weight of the sample became constant. In the course of these experiments it was found that wheat was more susceptible to variation in supplies of moisture than maize, especially on account of the distribution of its stages of development according to season; in fact wheat suffered much more than maize from drought in spring. For the production of a given quantity of grain, wheat requires more moisture than maize and, curiously, the consumption of moisture for a given quantity of grain is greater for wheat during dry than during moist years. The author explains this by observing that the vegetative organs do not economise in the moisture which they consume; they draw from the soil all the moisture they can, in developing their foliage, which increases transpiration; if drought occurs afterwards and the moisture remaining in the ground is insufficient, the grain develops incompletely and the crop yields more straw than grain. He terms this "biological drought". Species of plants with periods of growth as short as possible and which yield less straw, should therefore be selected, especially for years of drought.

The results reached by the author in his experiments are formulated in the following conclusions:—

(1) Fallow does not cause any accumulation of moisture in the soil in spring.

(2) The reserve of moisture in spring in the strata of the soil occupied by the roots of crops, to a depth of 125 cm., does not depend on autumn tillage nor on the previous crops.

(3) Wheat and maize, after the harvest leave similar quantities of moisture stored up in the soil; these two crops therefore have the same agricultural value for the crops that come after them.

(4) The stratum of soil ordinarily occupied by the roots — from 0 to 125 cm. in depth — always accumulates a large amount of moisture towards spring, 50 % of which comes from the winter rainfall and 16 % from the annual rainfall; this accumulation of moisture in the upper layers of soil should be attributed to the condensation of aqueous vapour which is set free in the lower strata of the soil.

VI. The paper by Prof. VIAZOVSKY contains fewer suggestions which are capable of being used directly for the control of drought than that of Prof. LEBEDEFF. The facts ascertained in the course of his experiments and of his careful observations, the results of which are recorded in a series of tables, while they have enabled known facts to be verified and confirmed, have not, however, resulted in many new conclusions.

It is known that active vegetation produces under the shade of its cover, peculiar atmospheric conditions differing from those of the surrounding area which is not covered with vegetation. The temperature and the degree of humidity of the air are quite different under the cover of plants

and outside such shelter. This difference is maintained, not only under the influence of daily sunshine, but also at night. The absolute and relative humidity of the air is always greater, not only under the cover of plants, but also in the strata of air immediately above them, in comparison with those registered at the same height where the ground is bare.

The air passing over a field covered with vegetation therefore becomes charged with humidity which is transported as the air moves. The temperature always being lower under the shelter of foliage, even during the night, with saturated humidity, than in the surrounding air with a bare surface, it is evident that these phenomena depend exclusively on radiation, and not on transpiration of the leaves. At the same time, the temperature is much more constant under the shelter of foliage. The author found that the temperature under these conditions remained relatively high, not only during sunshine, but also in the early hours of the morning.

It is well known that oats seldom succeed in the region of the Don and the Northern Caucasus. The author places this fact in correlation with the recently observed fact that the ostioles open and remain open for a long time when the temperature, reaches 39°C., and that after 4 or 5 hours, all the starch in the plant disappears, being transformed into sugar and carried away in solution in the sap. The same phenomenon has been observed for spring wheats after 10 to 17 hours under the influence of the same temperature, and for winter wheats and barley after 20 to 35 hours. It is evident that, in these conditions, the plants yield scarcely any grain. Oats are also subject to another drawback in the climate of this country; even during the most favourable seasons, the grain ripens too early, while the stalks and the leaves are still green.

VII. The work of Prof. IVANOFF is a general paper, of much larger scope than the former articles. Its general character of critical analysis and its importance for giving direction to further studies have already been indicated. The following is a more detailed review.

Although it is well known that transpiration by the leaves of plants is infinitely greater than is necessary for the production of plant substance, M. IVANOFF does not agree with the opinion of those who consider such transpiration superfluous and who would restrict it by all means. It is true that mineral elements can penetrate into plants independently of the absorbing action of transpiration as is the case with aquatic plants; it is therefore osmosis on one side and the pressure of the roots on the other, which causes movement of the sap. However, to get a rapid ascending movement, without loss of energy caused by the pressure of the roots, transpiration must necessarily intervene. The author remarks that the ascending sap not only contains mineral but also organic substances, sugar and enzymes (amylose and oxydase). To render possible the exchange with the liquid of the cells, the concentration of the sap must not be too great but it must pass in large quantities. Moreover, experiments and observations have clearly shown, that when transpiration decreases noticeably, for example on account of excessive humidity of the air, the crop becomes abnormal and defective, not only in quantity but also in quality. This is explained by deterioration of the tissues of

the plant, under the influence of decreased transpiration. In fact, the intensity of transpiration and the quantity of liquid transported determine the degree of turgescence of the plant, which has, like every character, its "optimum" point, very important for resistance to cold and pests. Transpiration therefore acts as a regulator for the influence of the temperature.

The author then discusses the indications of xerophilism, which in his opinion are still far from being decided. The action of the stomata, ostioles, hairs, the cuticle and wax, as regulators of transpiration has not yet been properly defined. Certain writers think that the width of the ostioles and the opening of the stomata do not correspond with the intensity of transpiration, the opening of the stomata depending rather on the light and the stomata serving rather to store up the carbonic acid gas of the air, than to transpire moisture. KOLKUNOFF's discovery, previously referred to, is not, in the author's opinion, either really conclusive or clearly explained theoretically. He considers the size of the cells as a merely empirical indication of xerophilism, and attributes no greater value to the point than to the observation that the number of stomata is not reduced in xerophilous plants ; the same is true for the number of hairs, the thickness of the cuticle and of the layer of wax which covers it.

The methods of investigation need improvement and attempts should be made to measure exactly the diffusion and traspiration through the stomata, and the registration of transpiration should be done not only in the laboratory but also in the open field, in normal conditions of the life of the plant. For the moment, there is not yet any acquired knowledge except the conclusion that the so-called xeromorphous structure of the plant is not a sure indication of decreased transpiration, and still less of resistance to drought.

None of these so-called indications is sufficiently established to serve as a basis for a work on selection, with a view to obtaining subjects and lines of plants resistant to drought. Moreover, the intensity of the process of transpiration by the leaves is far from corresponding always with the resistance to drought ; in other words, it is not always the plants which resist drought which transpire the least moisture, and vice-versa. Neither is it known whether the intensity of transpiration decreases under the influence of drought, nor in what manner such reduction takes place when it is produced.

Other indications of xeromorphism in the structure of the root system have been sought for, but no clear result has been reached. Fortunately in this part of the research it was possible to make observations on plants growing in a suitable environment. Resistance to drought depends in the first place on the power of absorption of the roots, and next on their structure. The power of absorption can be measured by the plasmolytic method, by the osmotic pressure. It has been found that the osmotic pressure increases with the drought and in certain plants can attain up to 40 and even 100 atmosphere, varying always up to a certain limit for each species of plant. As a rule, however, the capacity of absorption of the roots exerts a more decided influence on the rapidity of absorption of moist-

ure by the plant, than on the quantity of moisture which is supplied to it. The degree of humidity of the soil at which the supply of moisture no longer suffices to cover its loss by transpiration has been calculated for various plants; that value has been called "the wilting coefficient" and it has been found that the variations from one plant to another do not exceed a limit of 10 %.

It should also be remarked that the whole of the moisture contained in the soil is not accessible to plants, for a certain amount of water is always retained in the soil, in virtue of the capillarity and the hygroscopicity of the colloidal particles. The richer the soil is in humus and colloidal matter, the greater will be the amount of moisture which remains inaccessible to plants. In these limits, the plants which have the power of increasing osmotic pressure, owing to absorption by the roots, are in the most favourable conditions for resisting drought, and selection, based on this character should be possible. Moreover, the arrangement of the roots and rootlets in the soil must also have an influence. If the distance between the rootlets is sufficiently large, so that the zones of soil drained are not in contact and the ascending movement of the moisture is very slow, part of the capillary moisture contained in the rhizosphere will remain unutilised. The structure of the root system will therefore correspondingly increase the resistance of the plant to drought according as the rootlets are sufficiently well developed in the strata of the soil containing available moisture, to utilise the whole of that moisture. But these strata of the soil not being always necessarily at a great depth, even in dry localities, it is not surprising that it has not been possible to establish a necessary correlation between the resistance of the plant to drought and the length of its roots.

Among indications of xeromorphism have also been reckoned other characters whose importance cannot be denied, but the comparative study of which is still very imperfect. These characters include the capacity of the plant for conducting water from the roots to the leaves, passing through the stalk. It is evident that the structure of the vessels, which conduct the ascending sap, must play an important part in resistance to drought, but up to the present study of this question has not given other indications than the simple fact that xerophilous plants have a fuller vascular system than plants which have little resistance to drought. It is also known that the capacity of the plant to absorb moisture through its roots does not always correspond with that of conducting it to the leaves through its vessels ; in these conditions the vascular system may become a limiting factor for the supply of moisture to the plant. But the relation which necessarily exists between this factor and resistance to drought must still be made the subject of further research.

The contribution of moisture by the atmosphere is certainly possible and should have an influence in resistance to drought. It is stated that the plant is unable to utilise directly the aqueous vapour in the air, although its presence exerts an influence on the intensity of transpiration of moisture by the plant. As regards dew, it is certainly absorbed directly by the plant, but it is not known what part this factor plays in resistance to

drought. Sprinkling experiments on plants and the observation of the effects of showers of short duration indicate that if the temperature is high and the air very dry, this contribution of moisture may often become harmful to the plant. The phenomenon, indeed, has been observed, but not yet explained in a plausible manner, that these sprinklings render transpiration so active that as a final result the loss of moisture exceeds the supply, and the plant wilts. This question also deserves further research. Still further indications on the possibility of utilising certain peculiarities in the growth of plants for the control of drought are found in the literature on the subject. These peculiarities, which are in fact anomalies, are the phenomena known under the names of nanism, anabiosis and ephemerality. Nanism in the faculty which plants have of reducing their size under the influence of drought. In spite of its restricted development, the dwarf plant is able to produce fruit and seeds which have the power of germinating, but for cultivated plants the yield is naturally much reduced. If the plant is affected by drought, not from the commencement of its growth, but when growth is already finished, some plants lose a large portion of their leaves and reduce their vital functions to a minimum; they enter into a phase of torpor and repose, to renew their vegetative vigour as soon as rain occurs; this is termed anabiosis. Certain of our cultivated plants have this power, which could perhaps be turned to account to counteract a drought of short duration, but the question has as yet been too little studied sufficiently to formulate any conclusion.

The same is true for the question of ephemerality, which is the capacity of the plant to change its habit of life so as to become acclimatised to an arid region, that is to say to reduce the duration of certain phases of development utilising for development the dampest periods only of the climate. It is thus that the wheats of Turkestan develop from their germination, so vigorous a vegetative activity that they come into ear long before other kinds, and with an astonishing luxuriance of vegetation; the second part of their life, up to maturation, is on the contrary very inactive and slow. This peculiarity enables them to support the spring drought without harm and to await the late rains in June. Lastly, the low temperature of the soil in spring in Central Russia favours resistance to drought in oats by checking the development of the foliage, while the roots maintain a normal growth; the plant having few leaves transpires less moisture and stands the drought well.

All these peculiarities are phenomena of acclimatisation, which deserve full attention in the study of the control of drought. Prof. IVANOFF notes the great complexity of the problem and the absence of definite results in its research. Not one of the indications of xeromorphism in our cultivated plants is as yet quite certain. Now, the problem to be solved is to find, even by empiric methods, a xerophilous type of each cultivated plant and for each climatic region. Laboratory experiments are not sufficient for an adequate solution of this problem, they must necessarily be combined with observations of plant life as displayed in normal conditions and their results must be confirmed by such observations.

It is also necessary to define what is to be understood by " resistance

to drought ", that is to say, what is the degree of drought which becomes injurious for each crop in each locality, and what are the manifestations of drought which cause injury to crops, whether it is deficiency of moisture in the soil, or dryness of the air, high temperature, too intense sunshine or mist, which damages any particular crop. In fact the capacity of resistance of plants to each of these injurious influences is certainly different . Lastly, the relation between the periods of drought and their duration on the one hand, and the phases of development of cultivated plants on the other, must be studied. Needless to say that comparisons between one plant and another are only to be made in this research with great discretion, and this not only because of the properties of each type of plant, but also in view of the different objects of their growth, since it is, for example, in one case the seed, in another the root which forms the most valuable part of the crop. This work may therefore be considered in the first place as an ecological investigation. The conditions of the medium, the meteorology of drought, must first be studied; research should next bear upon the morphology, anatomy and the phenology of cultivated plants, to finish with the study of their physiology, always from the point of view of their resistance to drought. The question having the character of a purely ecological problem, we must begin by elaborating methods which may lead to solution, seeing that ecological methodology is still in a rudimentary state.

VIII. The articles by MOLIBOGA and MAKSIMOFF do not directly attack the problem of the control of drought in Russia, but they afford some idea of the scientific apparatus existing in Russia which could be used in the execution of the full research proposed by Mr. IVANOFF.

Mr. BOLIBOGA states that the system of agricultural meteorological stations, established in Russia on the initiative of Prof. BROOUNOFF in 1897, had begun to have a more or less important development just before the war. Fifty three of these stations were established in Russia in 1913. Since then, political events have not only stopped this development, but have even destroyed a part of the work done. A commencement has been made to re-establish, it, but in 1923 the system contained only 33 stations, most of which had insufficient apparatus. The Central Bureau has collected and preserved an enormous quantity of material recorded by the stations during the whole of the past of years, but this material still awaits elaboration.

IX. M. MAKSIMOFF sketches the programme of research in agricultural meteorology, partly undertaken, partly to be continued, with a view to the control of drought. The factors to be studied are : — the atmosphere, the water supply, the properties of the soil, temperature, light, and the combination of these factors in variations of weather.

Changes of weather should be studied in their relation with the various phases of development of plant growth. It is necessary to determine for each crop the " critical periods " in Prof. BROOUNOFF's sense.

As regards methods, a series of parallel observations should be made on the normal conditions of plant growth and on artificial conditions under glass and in pots.

The author indicates the principal objects and methods of research in the open field, namely :—

(1) Sowings at different times and phases of development.

(2) Sowings in different localities and in different climatic conditions.

(3) Experimental irrigation. This method, by elimination of the principal factor, *i.e.* the water-supply, would make possible the separate study of the influence of temperature and light. To eliminate these two last factors, recourse would have to be had to growth under artificial conditions. It is possible to regulate and vary the influence of light by the use of screens. It is possible to supply plants in greenhouses with more or less dry and more or less warm air. Growth in pots has certainly the drawback that the root system is always somewhat compressed. For this reason this method is not suitable for research of a complex nature, but it may well be used to determine separately the influence of each factor, for example, the humidity of the soil, the amount of water consumed, the coefficient of transpiration, etc.

The interpretation of all results of investigations on growth carried out in artificial conditions requires great care. G. Z.

148. Agricultural Meteorology in Italy.

PAOLONI B. La meteorologia agraria in Italia. *La Meteorologia pratica*, Year VI, No. 3, pp. 93-107. Montecassino, 1925.

The author of this article, Father B. PAOLONI, a student of meteorology, has for many years endeavoured to make practical application of purely scientific meteorology to the requirements of agriculture, which in Italy is of vital importance to the country. According to the author, one of the principal shortcomings of the Italian meteorological service is perhaps that not only does it still remain too much in the purely scientific stage, but to this is added the very serious defect of want of adequate means and of concentrated effort.

In Italy, where it may be said that pure and agricultural meteorology originated (the first phenological observations were made in the Orto dei Semplici at Florence in 1810 and compared with meteorological data of the corresponding period), and where up to a few decades ago through the medium of descriptive articles and the work of students of the science, such as Conte ALMERICO DA SCHIO and Dr. LAMPERTICO, much might be learnt even by foreign countries, the situation is now one of absolute inferiority, compared with many other countries.

Attempts have been made to coordinate, over wide zones, meteorological agricultural observations, making at the same time investigations as to the principal families of cereals and the chief varieties of fruit trees, but after a short time, for one reason or another, the movements, even when supported and actually promoted by the Government (as in 1886) have failed. Today there exists in Italy the *Rivista Meteorico-agraria*, published under the auspices of the Central Observatory of Meteorology, but, apart from its modest dimensions, it is solely devoted to general

agricultural meteorology and, moreover, a large part of the observations relative to agriculture reported in it are not the work of specialists nor even of persons of real specific competence. Today, except, for some private movements (of which the most impotant, if not the only one, is the meteorological system existing in Terra di Lavoro, founded and managed by Father B. PAOLONI) there no longer exists any indication on the part of competent organs of a serious intention of dealing with the matter.

Under this scheme there have been and still are collected the principal meteorological reports relating to phenological data of a considerable number of plants, subdivided into nine groups:— cereals, fodder plants, leguminosae, industrial plants, vegetables, vines, olives, fruit-bearing and forest trees.

On the side of the Ministry of Agriculture, in consequence of the increasingly great diffusion in foreign countries of ecological researches tending to determine the *characteristic environments of each plant and the most favourable conditions for perfect growth*, an attempt was made some years ago to start in Italy a service of agricultural meteorology which, without being as extensive as that which existed in Russia before the war, might however form a solid starting point for the definite organisation of this most important branch of agricultural research.

Unfortunately, however, partly through a great disproportion between means and the object and perhaps also through want of enthusiasm on the part of those from whom it might have been expected, even the circulars sent out with this object remained dead letters and the inconsiderable amount (L. 45 000 a year) assigned to this object was not even fully utilised.

The capital mistake, however, at the outset was to try to duplicate the Central Bureau of Meteorology, instituting a new centre of collection of meteorological-agricultural reports in the Ministry of Agriculture, when the Central Bureau already organised to receive reports from all sources, and only requiring more adequate economic means and improved methods, could very well have done the work. Nothing, however, has so far been achieved, but there is every reason, in the present necessity for increasing the production of wheat, to apply to that end the aid that could be given by meteorology.

Meteorology is among the very first of means. Without asking, even remotely, for such a sum as the 50 millions which the United States spend annually for the agricultural meteorological organisation, without asking, at present, for the magnificent French organisation which is instituting in each commune a radiophonic station which four times a day will broadcast to the farmers the forecasts of the Central Observatory for the following 24 hours, it is possible to establish by a single act of goodwill a really practical and useful service placing it under the Central Bureau in Rome, the new service to be charged with the duty of supplying farmers with the following daily items:—

(*a*) Regular forecast of a general character, once or twice a day.

(*b*) Notice of periods of fine weather with the progress, for the region, of the more important meteorological phenomena.

(*c*) The termination of the periods.

(*d*) Announcements of frosts and storms, especially hailstorms.

(*e*) Peculiar hygrometric conditions favourable for the spread of parasites and diseases especially injurious to certain plants.

The forecast for the 24 hours is now accurate 90 times out of a 100; the local experience of each farmer would supplement and improve the forecast in each centre.

Nor would this be the only collaboration which might be required of the farmer himself; he also should despatch for each place periodically, to the Central Bureau, such information as, after careful consideration, would permit of the periodic compilation of a general statement of the meteorological-agricultural situation of the country and of its immediate and remote agricultural prospects. There will thus be the possibility, in each region, of the adjustment of the growing of various crops to the climate and minimum amount of the summer rainfall.

This is not a small matter as in Southern Italy where delay in sowing wheat from faulty estimation of the duration of rainy periods, may lead later, in the dry season, to loss of the crop with damage of over 500 million lire. An equal or even greater loss may occur in the case of forage plants, and other large amounts for vines, olives, fruit and vegetables, so that over two thousand million lire a year is at stake, and may be saved by an efficient agricultural meteorological organisation.

A. FA.

149. Methods of Weather Forecasting.

ROUCH J. Les méthodes des prévisions du temps, pp. 280. Félix Alcan, Paris, 1925.

New methods in relation to the forecasting of weather with reference to its application to agriculture have been suggested by VERCELLI.

The work in question omits all preliminary matters, and deals only with the subject of *forecasting*, referring in certain instances to former works by the same author on static and dynamic meteorology. In the 280 pages of the volume, various methods of forecasting are considered and discussed in sufficient detail.

The book is divided into three parts:

Empiric forecasting, local forecasting, general forecasting, on the basis of simultaneous observations made on a large scale. The first naturally forms a large section dealing with the knowledge transmitted by means of proverbs, aphorism relating to various phenomena, observations of the behaviour of certain plants animals; etc.; a very large mass, the value of which is in many cases disputable, but the interest of the subject is not thereby lessened.

In the other two parts are set out the methods of scientific forecasting. There are naturally differences of opinion, due largely to the incomplete knowledge possessed with respect to the atmosphere and particularly as regards solar radiation. Moreover many lacunae still exist in the knowledge of the relations between statosphere and trophosphere, the basis

factors being absent, which might serve as criteria of the principles of weather forecasting.

These, on the other hand, vary according to circumstances and according to certain types of weather so that a method may from time to time prove effective or not even allowing that in its application there may still be, to a certain extent, empiricism, and the factors of individual skill.

On the other hand, no rule regarding such a complex matter as forecasting must be too narrow and rigid, and a selection from the standard methods is necessary. The author admits that this procedure may be slightly unscientific but is due to the early stage of the young science in question.

It would indeed be a mistake to derive a rule of general application from the formula of a standard method, whereas the wise use of its fundamental elements may always furnish and constitute a useful contribution to those already possessed, leading to the elucidation of the problem the manifold aspects of which constitute its difficulty. A. FA.

150. **Principles of Practical Weather Forecasting.**

SANSON J. La Prévision du temps. *La Vie Agricole et rurale*, Vol. 26, No. 22, pp. 353-356, Fig. 2. Paris, 1925.

The author discusses some of the principles of practical weather forecasting, chiefly founded on records of the wind and clouds, of animals and plants, with a short note on the atmospheric " parasites " observed by means of radio-telegraphy. The importance which the observation of clouds, especially in recent years, and particularly, the higher clouds — usually cirri — heralding the arrival of depressions, has assumed, is noted. From these observations it is possible to deduce some general principles which have considerable practical value.

(1) With light winds, variable in direction and with a sky almost free from clouds, with morning mist or abundant dew, there is in all probability an anticyclonic condition (high pressure). A certainty of settled weather is then probable. However, with light southerly winds accompanied by a rise in temperature, especially in the morning, and with high cumuli scattered over the sky, thunder storms or atmospheric disturbances are to be feared, especially in summer. Regular daily variations in the velocity of the wind, that is to say the passage from a light current in the morning to a more considerable current, coincident with the maximum temperature of the day and with decrease at sunset, indicate a settled condition.

On the other hand a change of weather is to be predicted, if in the course of a fine day, the wind continues to remain strong in the evening and at night.

Rapidly moving cirri, coming from a direction between south and north-west (3rd and 4th quadrants) should give reason to suppose, especially in May and October, that a depression is coming whose centre is

situated slightly to the right of the direction from which the clouds come.

These cirri may precede the depression by 24-48 hours, according as the observing station is situated on the edge or in the centre of the nebulous mass; in this case rain or dry weather will depend on the distance of the station from the centre of the depression. The appearance of high cumuli coming from the above-mentioned direction may give similar results.

(2) By forecasting the direction of the wind, it is possible to predict changes of weather. Indeed, for a given place, certain almost constant characters of the weather correspond with the direction of the wind. For each station it is therefore possible to draw up special charts of frequency of the wind according to the various directions, i.e. graphs which, illustrate the atmospheric currents apart from their intensity According to the prevailing directions, observation will disclose types of weather not liable to change while the conditions which have determined them continue.

(3) Certain aspects of the atmosphere also furnish good indications for a local weather forecast. Rain is preceded by exceptional clearness of the air, by better perception of distant sounds (especially those emitted in the direction of rainy winds), by increased twinkling of the stars, by the occurrence of solar and lunar halos (especially the former); by the fact that the clouds are massed in the direction towards which the wind is blowing and by other indications of minor importance which may naturally vary from one region to another, especially in countries round the Mediterranean. The various colorations of the sky at dawn and sunset are also important.

If the sky is pale or grey in the morning, or orange-red in the evening, fine weather will continue; brilliant colorations at dawn, almost always indicate rain. A yellow sky at sunset indicates wind, while when the disk of the sun appears to undergo certain characteristic deformations it is always a sure sign of rain.

Other chromatic indications, useful in forecasting, were recorded centuries ago as popular ideas based on experience, such as formed the subject of poetic treatment in Virgil's Georgics, and have been taken up recently, developed and propounded by Father PAOLONI of Montecassino, as an aid to weather forecasting under the title of "Virgil's Method". The observation of the higher air currents, determinable by observation of clouds (BESSON nephoscope) can also furnish useful indications for forecasting. If the wind below becomes stronger and the higher clouds travel in the opposite direction, or in a direction forming a fairly wide angle, it may be predicted that the wind below will give place to the higher current. Two winds succeeding each other in opposite directions almost always bring rain. In this respect, in winter, the case of the hot, very dry, South-East wind which is apt to blow on the Mediterranean Coast of Africa and which is invariably followed by a North-West wind bearing rain, is typical. Generally, rain may more easily be predicted, the more superimposed strata of clouds are present in the sky. Settled clouds in the direction whence the wind blows, only bring a continuation of the same air current; if on the other hand they appear in the

opposite direction, they announce the termination of it. When clouds collect from different directions, they indicate a thunderstorm ; clouds collecting on the slopes of a mountain indicate rain.

(4) Certain animals are able to give indications regarding change of weather ; thus the behaviour of cats and birds on the approach of rain is known. On the approach of bad weather, flies become more troublesome and sea-birds come in greater numbers to the coast and fly lower. On the other hand, with fine weather, swallows fly higher, butterflies are more numerous, spiders weave their webs more actively, and flies fly even after the sun has set. Certain plants also can indicate the coming state of the weather and both in the case of animals and plants such behaviour is explained by variation of the hydrometric condition of the air when the change of weather is indicated.

(5) Since meteorological phenomena are always accompanied by more or less intense electrical manifestations, the importance in this respect of receivers of electric waves in wireless telegraphy is evident. The principle in itself, indeed, is not new, since in 1787 a priest, M. VENTAN of Burki (near Basle) had invented a kind of harp with 15 strings of different thickness, over 90 metres long, stretched on large cylinders and arranged at suitable distances from each other. The instrument (meteorological harp) was placed in a North to South direction and inclined so as to form an angle of 20°-30° with the horizontal. During changes of weather the harp gave vibrations of various strengths according to the distance and magnitude of the depression which it indicated. The receivers of wireless telegraphy can pick up the so-called atmospheric "parasites" or disturbances, the intensity of which is variable and at present classified in three categories :— rustling, crackling, cracking. Th- crackings indicate the approach of a hurricane close to the station, e the crackings increase in intensity and frequency ; it is retreating if they decrease. Slight rustlings, similar to the sound of frying, indicate the coming of a hail cloud ; numerous cracklings, on the other hand, are indications of the occurrence of a large depression. If the isobars of the depression are concentric, the direction of maximum crackling will be that of the South and South-East sectors. Rain and mist make reception fairly good, the contrary is the case when the air is dry and cold.

A. FA.

151. **Forecasts of Stormy Squalls by means of Radio-Telegraphy.**

MUGNIER-SERAND J. Recherches en vue de la prévision des grains orageux en Afrique Orientale Française au moyen de la T. S. F. *Bullet. du Comité d'Etudes Hist. et Scient. de l'Afrique Occidentale Française*, No. 3, pp. 177-185. Paris, 1924.

At the station of Conakry (Gulf of Guinea) since 1919 and onwards M. MUGNIER-SERAND has undertaken a series of investigations with regard to the forecasting of stormy squalls, especially those which bring hail, by means of wireless telegraphy.

The first results obtained encouraged SERAND to renew his researches systematically in 1922, by making use of the apparatus on the antennae

and that on the radiogoniometric square. The object of the observations made on the square was to determine from the auscultation of " atmospheric parasites " perceived by help of the apparatus, the position of the storms and possibly to follow their course, determining also, as the storms gather, in what direction the parasites were most numerous. The apparatus used for this purpose consisted in the following parts.

Square with flat spiral of 1.45 m. × 1.45 m. 106 spirals about 8 mm. apart with a total length of 355 m. A 10/10 copper wire covered with two layers of cotton.

Plugs, dividing the roll into 5 parts. Condensor capable of being regulated by air 2/1000 m-d. Amplifier by resistance ; three valves one of which was detecting and compensating.

Listener of 2 thousand ohms.

This square was suspended at 1.80 m. from the floor inside a room with a roof of corrugated sheet iron.

The installation under the sheet iron was probably not the most favourable for the satisfactory reception of signals, but it was impossible to find on the hill (80 m. above the sea) any other more suitable place. Moreover, experiments made in the open air have shown that there was not an appreciable difference between signals received in this way and those obtained under the above-mentioned shelter. The brevity of the period of observation did not allow of conclusions being obtained; one fact, however, dominated the others, which was that except for a few rare exceptions, it was never possible to perceive a decided maximum of "parasites" in a determined direction. This is due to the fact that the observations were made at a time when there were almost daily formations of stormy squalls accompanied by an extraordinary abundance of atmospheric parasites.

It is on the other hand now proved that in French West Africa such parasites appear on a regular front of immense length, but with more or less marked sinuosity and with a general direction E-W.

From observations made with antennae during a longer period, M SERAND draws on the other hand the following conclusions : In Guinea, stormy formations are accompanied by a peculiar abundance of atmospheric parasites, a sort of preparation by electric artillery, a phenomenon which generally exhibits a fairly regular progression. After a certain time from the commencement of listening, the discharges are succeeded by a rhythmic noise which SERAND compares to that of frying, interrupted by periods of more distinct sparkings more or less prolonged. Taking into account the average velocity of stormy squalls estimated by HENRI HUBERT, at about 60 km. an hour, it is thus possible, with the installation described, to forecast the arrival of a storm 250-300 km. distant and therefore 5-6 hours before its arrival over the stations.

The following examples illustrates the progression of the sound of the " parasites " indicated : —

At 6 a.m. = 2 (index of sound) ; at. 9 a. m. = 2 ; at 2 p. m, = 4 (continuous sound); at 5.p.m. = 4 (discharges at intervals) ; at 5.30 arrival of the squall over the Station. This listening through wireless telegraphy enables, in a certain sense, weather pulse ta be felt.

Certainly the best solution for giving greater value to this method would be the employment of registers which would automatically record the atmospheric parasites, were it not for the fact that their use in restricted by the high cost. Undoubtedly, however, such apparatus and the direct observations indicated by it, may be a valuable factor, the use of which would tend progressively to become more common for forecasting weather in any given region and with great advantage especially to agriculture.

A. FA.

152. **Weather Conditions and the Yield of Almond Trees.**

EREDIA F. La previsione dell'entità del prodotto del mandorlo di un'annata in base all'andamento della temperatura dell'aria ed alle precipitazioni nel trimestre gennaio-marzo. *Rendiconti della R. Accademia nazionale dei Lincei*, Vol. I, ser. 6, half year 1, No. 9, pp. 548-552. Rome, 1925.

Variations in the yield of almonds are noted from year to year, sometimes so considerable as to affect the importance of the crop to a large degree. It is considered that a rapid fall in the temperature of the air and a succession of more or less intense frosts during the period when the almond trees begin to set their fruit, are the causes which more or less directly produce such variations, since in that case not all the small almonds, exposed to such conditions without protection, come to maturity.

More important than the sudden fall in temperature which has more influence than any other local conditions affecting the crop, are the general climatic conditions and for this reason the author has made investigations with respect to the general climatic conditions during the period from January to March in Apulia and Sicily, studying them with regard to the crop.

From the data collected, a relation has been shown between the thermal and pluviometric variations and the yield of the crop. Not only the falls of temperature in March have a decisive reaction on the value of the crop, but the whole course of minimum temperature and rainfall throughout the period from January to March also affect the crop. Uniform deviations in the minimum temperatures in the three months mentioned, in conjunction with not too heavy a rainfall, constitute the best conditions, which are less favourable when such uniformity is lacking and when, after a warm January, a cold February and March follow with heavy rainfall irregularly distributed over the region.

On the basis of the meteorological observations of the current year the author predicts that the crop will be approximately normal in Sicily; it will be slightly below normal in Apulia, because some species of almond tree were caught by falls in temperature while they were in full blossom.

A. F.

Fertilisers and other Products Useful to Agriculture.

153. **Investigations on Stable Manure.**

ZIELSTORFF and ZIMMERMANN H. (Agrikultur-Chemisches Institut der Universität Königsberg). Der Stalldünger, seine Aufbewahrung und Behand-

lung im Wirtschaftsbetriebe und sein Gehalt an wichtigen Pflanzennährstoffen unter heutigen Fütterungsverhältnissen. *Landwirtschaftliche Jahrbücher*, Vol. LXI, No. 2, pp. 236-283. Berlin, 1925.

The value of stable manure depends principally on the composition of the food given to the animals and on the method of storing and treatment of the manure. War conditions have brought about considerable changes in the feeding of cattle and consequently a decrease in the value of stable manure, a decrease which, in the case of Germany, was estimated in 1920 at 250 000 tons of nitrogen and 70 000 of phosphoric acid.

The object of this work is to define the present conditions and to estimate the present value of stable manure for application to the land. Peat is often used now as a litter, which entails a further decrease in manurial value.

The values found by the author are compared with those previously ascertained by other investigators. Thus we have for *stable manure*, estimating the dry matter at 25 %:

	P_2O_5	N	K_2O
STUTZER's values	0.350 %	0.700 %	0.800 %
HOLDEFLEISS' »	0.270 %	0.543 %	0.666 %
The author's »	0.200 %	0.538 %	0.662 %

STUTZER's values however, cannot be considered as average, but only as maxima ; on the other hand making the comparison with those of HOLDEFLEISS, which may be taken as corresponding to average conditions, it appears that there is at present in the case of stable manure a decrease of about 25 % in phosphoric acid, while nitrogen and potash may be taken as unchanged.

The following are the values for *sheep manure* on the 32 % of dry matter :—

	P_2O_5	N	K_2O
STUTZER's values	0.250 %	0.850 %	0.670 %
The author's »	0.365 %	0.785 %	0.713 %

The higher values for phosphoric acid and potash are attributable to the fact that the manure was in a more advanced state of decomposition.

In the case of *manure heaps in the open*, the author obtained :—

P_2O_5. 0 232 % N. 0.449 % K_2O. 0.557 %,

which are all less than the lowest values given by STUTZER.

The author's researches indicate that in large farms the feeding of cattle is now much improved and that the manure is being properly stored ; the conditions on small farms, for which considerably lower values were obtained, are less favourable. The new system of treatment of manure by fermentation at high temperature is not yet common in Germany ; on the only farm visited by the author the required temperature was never attained.

Analyses of drainage effluents from horse stables have shown considerable differences, namely :—

for nitrogen from 0.11 to 9.92 gm. per litre, and potash from 0.43 to 17.87 gm., with prevalence of the lower values, so that more than half the

samples (55 %) contained less than 2 gm. of nitrogen and 5 gm. of potash per litre. The average values are 2.52 of nitrogen and 5.69 of potash, which are very similar to those of STUTZER who obtained 2.3 and 4.6. The proportion of K_2O/100 N. varies from 70 to 24.

The drainage effluent gave an average of 7.33 of potash and 3.57 of nitrogen ; the proportion K_2O/100 N varied from 35 to 76.

The differences in the results vary considerably according to the size of the farm and to the various conditions of storage.

From the investigations recorded it may be concluded that the storage and treatment of manure still result in considerable loss which, so far as nitrogen is concerned, is capable of being much reduced by means of scientific treatment.

It should also be kept in view that, the present methods of feeding animals, results in a considerable decrease of phosphoric acid, while deficiency of protein in the feeding is not reflected in a corresponding decrease of nitrogen in the manure. The values for potash remain unchanged, or even, at least as regards the drainage effluent, seem to have slightly increased.

A. F.

154. **Sugar-Cane Trash as Manure.**

HARDY Prof. F. *Tropical Agriculture*, Vol. II, No. 6, pp. 121-122. Trinidad, 1925.

The investigations at Rothamsted have shown that micro-organisms, responsible for the breakdown of straw, cane-trash and similar vegetable matter that may be applied to the land, require nitrogen for their sustenance. Consequently, nitrogen in the form of urea in urine, or other compound, must be added before satisfactory cellulose fermentation can be obtained. If not added, the micro-organisms may draw on the nitrogen reserves of the soil, and this may lead to diminished crop yields.

Cereal growers have found that ploughing in fresh straw generally results in a depression in yield of the succeeding crop. The investigators at Rothamsted suggested that a leguminous crop should immediately follow the application of fresh straw, as that crop would be independent of nitrogen supply, and would provide sufficient nitrogen for the straw-decomposing organisms.

The action of straw chaff upon the development of root nodules of soya beans was studied, and a large increase of nodules was found to follow the addition of straw. However, the yield of the crop was not increased, because although the straw stimulated the infection of the roots with nodule organisms, it did not increase root growth.

Subsequently the combined action of straw and phosphate was tested, as it is well-known that phosphates stimulate root growth. The result was successful in preliminary trials and it is expected that a new system of manuring will be evolved, by which unrotted straw may be applied to the soil, followed by a leguminous crop manured with phosphates. In

this way nitrogen losses usually attendant upon the incorporation of cellulose material into soil may be overcome.

It is important that sugar-cane planters should take steps to conserve, or to build up the supply of organic matter in the soil, if serious deterioration in fertility is to be avoided. W. S. G.

155. **Guano-producing Birds.**

MURPHY R. C. (Amer. Museum of Natural History). The Most Valuable Bird in the World. *The National Geographic Magazine*, Vol. XLVI, No. 3, pp. 278-302, 20 fig. Washington, D. C., 1924.

If the advantages which various species of birds bring to humanity are expressed in hard cash, undoubtedly the first position belongs to those which produce guano and especially to the Peruvian cormorant, called "guanay", *Phalacrocorax bougainvillei.*

The *habitat* of this species is restricted to coastal waters of the arid western shores of South America between Punta Pariña, to the south of the Gulf of Guayaquil and Corral, in Chile. This stretch of coast, approximately 2 400 sea miles in length, is washed by a narrow oceanic current the Humboldt Current, which is considerably colder than the surrounding waters which have a temperature of 25-27°, while that of the current is about 15°. On account of the low temperature innumerable marine organisms live in the waters of the current, such as anchovies and other small fish which constitute the food of the Peruvian cormorant. They belong entirely to the Humboldt current, and move up and down the coast, following the fish, but never wandering beyond the limits of the current. The adjacent islands have the same desert character as the coast and to this fact is due the important economic character of the birds since their excrement has been accumulated on the islands without undergoing decomposition. Along the arid coast of Peru, where tempests are unknown, move dense flocks of guanays catching in their flight the fish which are nearest to the surface. At other times when the guanayes return to their nests from distant places where they have gone to get food, they fly in a dense unbroken stream which continues to pass for four or five hours.

The flocks, however, do not leave their nests without less ado in the morning, Some scouts go first who fly about here and there, rather high up, until their dropping and their divings indicate to the company left behind that the harvest may be good. The dense flocks than fly headlong and rapidly gorge themselves ; in a shot guanay, were found 76 anchovies 10-12 cm in length.

The guanay stands erect and walks like a penguin. It is about 50 cm. high and weighs a couple of kg. It has a glossy neck, green and blue-black and the back is also similar, while it is white in front ; during the pairing season a crest of feathers develops on the back of the head. The iris is brown, the eye is surrounded by an a.ea of naked green skin. The feet are pink.

They live in very numerous colonies of about a million ; on the slopes, sheltered from the wind, of the Peruvian islands, the density is such that

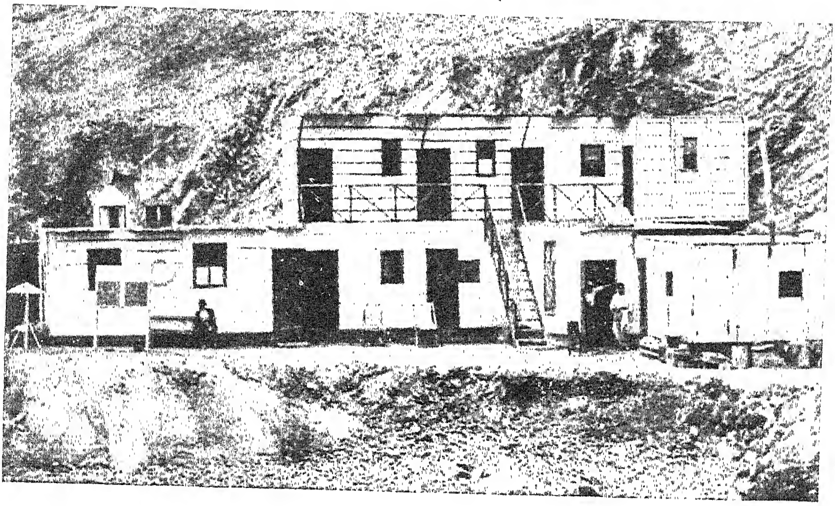

FIG. 53. — Guano administration laboratory and guardian's residence on Central Chincha Island.

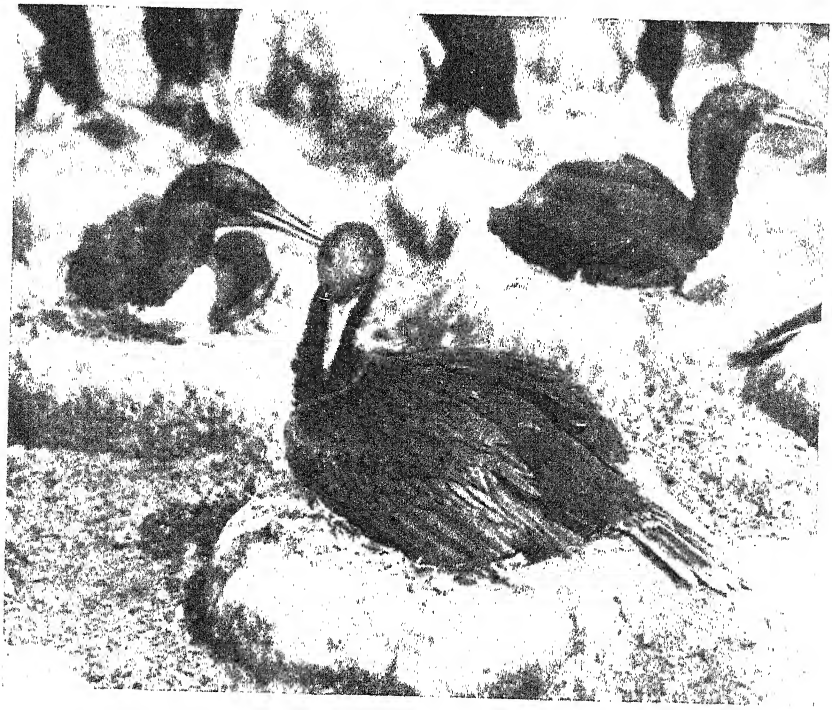

FIG. 54. — Guanayes incubating second sets of eggs at Pescadores Islands.

there are three nests to every square metre of surface. Each pair rear a couple of broods a year.

They are not frightened by noise, not even of gun-fire, but rather by the sight of unaccustomed movements; they then fly away and the motion of the wings of so many birds produces a roaring comparable to that of a train in a tunnel. During their resting on an island, the guanayes are fouled with fresh guano, from which they clean themselves flying at a certain distance on the lee-side of the island. The enemies of the guanay are mainly vultures and condors which feed on the eggs which they sometimes destroy by thousands. The guanayes are also infested with parasites (Mallophaga) which however, do not cause serious harm.

The collection of guano is now regulated by the Peruvian Government, while for some tens of years it was so chaotic and unregulated that it had led to the exhaustion of the old deposit. It is now raised to the dignity of a real industry, centred in the National Guano Administration which has made a regular sanctuary of each of the bird islands, always closed to unauthorised visitors. For each group there is a competent guardian who resides on the spot; clandestine extraction of guano is strictly prohibited, as is also the stealing of eggs.

There is a technical management which has carried out important researches in meteorology, zoology and on the diseases of the guanay. Every island is subject to a kind of rotation by which the birds are assured of tranquility for their nests. Some ten years ago, the quantity of guano extracted annually was less than 25 000 tons, it now amounts to 90 000, of which 70 000 are used in Peru itself and the rest exported. These are low figures compared with the millions of tons which were shipped from ports in Peru during the last fifty years of last century. But the old abusive exploitation exhausted the ancient reserves to such a degree as to bring about such depletion that the guano was no longer even sufficient for local requirements. With the new method, the colonies are repopulated and future production is assured. A. F.

156. **Field Investigations with Rhenania Phosphate.**

GISEVIUS Dr. and KLITOCH Asst. Dir. Felddüngungsversuche mit Rhenania-Phosphat zu verschiedenen landwirtschaftliche Kulturpflanzen. *Deutsche Landwirtschaftliche Presse*, Year LII, No. 11, pp. 129-130. Berlin, 1925.

The "*Rhenania*" union of chemical works have produced since the war from chalk-phosphates and Eifel-Phonolites by crushing, mixing and drying in rotatory-furnaces, a phosphoric acid manure, which though containing originally only 12-14 % of P_2O_5, now contains as much as 25-30 % of "citrate-soluble" P_2O_5. This considerable increase has been brought about by a series of improvements in the methods of production. It should also be pointed out that "citrate-soluble" means the degree of solubility as determined for commercial purposes. Superphosphate contains "water-soluble", basic slag contains "citric acid-soluble" and Rhenania-phosphat contains "citrate soluble" P_2O_5. The latter also contains 30-40 % of lime, which gives it a basic character, and it also contains ..5 %

of pure potash. Being very finely crushed it mixes thoroughly with the soil, is very dry and does not decompose. It is thus a very valuable product, which on account of its chemical and physiological properties can be used regardless of the character and the reaction of the soil.

To investigate the practical results which might be obtained with this fertiliser, a series of experiments was undertaken in the years 1922-24 by the Agricultural Institute of the University of Giessen. These investigations were extended to very widely differing soils and climatic conditions and had for their object in the first place, to investigate the specific influence of Rhenania-phosphate itself, and secondly to compare its action with that of the two other P_2O_5 fertilisers on the same soil. For each investigation, there were 2-3 plots of ground, each of 100 sq. metres. Each plot received an adequate amount of N and K_2O manure and was tilled in the locally customary manner. The hoed crops received a fair or heavy farmyard manuring. The R.-Phosphate was applied *before* tilling (on the average of 18 % P_2O_5 content at 0.35 marks per kilo per cent.), in the following amounts: 3 quintals per hectare under corn at a cost of 18.90 marks, partly 3 partly 4 q. per hectare under hoed crops and grass at a cost of 25.20 marks. In the case of rye R.-Phosphate gave an increased yield of 268-442 kg. per hectare, which after deducting the above cost gave a net gain of a hectare. The corresponding data for *spring-barley* and *oats* are:

Barley 238 kg.-310 kg. corresponding to 35.40-51.96 marks.
Oats 506 kg. corresponding to 66.96. marks.

Decrease of the danger of storage, acceleration of development of the grain and of ripening, are a few of the effects of P_2O_5 manuring. In the presence of an excess of nitrogen it tends to prevent a too luxurious leaf growth.

In the case of kohl-rabi its use caused an increased yield of the value of 33.12 marks to 123 marks per hectare. In the case of potatoes it gave an increased yield of value 14.82 to 38.44 marks per hectare. It should be pointed out, however, that for hoed crops R.-Phosphate proved superior to the other two P_2O_5 manures for 50 % of the investigations, while in 25 % of the cases no comparisons were instituted, and in the other 25 % the superphosphate and basic slag were found to be better manures. But even in this case R.-Phosphate accelerated the ripening and increased the quantity of reserve material accumulated.

In the case of grass land R.-Phosphate also has a very beneficial influence especially on the Leguminosae, which supply N to the soil. In two different sections on 5 meadows the value of the hay gathered was increased by 7.80-19.42 marks per hectare by the use of R.-Phosphate, which shows a considerable gain. Also, the quality was improved.

Where it is the custom to apply farmyard manure every three years, the addition of P_2O_5 is of value. Rhenania-Phosphate, being a concentrated fertiliser, saves transport costs, and as it is suitable for all types of soil, is worthy of careful attention. V. E.

157. Field Experiments in Ireland in 1924.

Journal of the Department of Lands and Agriculture, Vol. XXIV, No. 4, pp. 424-439. Dublin, 1925.

Details are given of field experiments carried out in Ireland during 1924, which included trials of phosphatic fertilisers, crop variety trials and experiments on the value of lime to a rotation of crops.

"Peerless" basic phosphate, produced in Belgium, gave results equal to those of high grade slag in the case of crops, and on pasture produced earlier growth than any of the other forms of phosphate tested.

Of the mineral phosphates, Gafsa appears to be the most effective. A mixture of Gafsa and superphosphate in equal proportion is now on the market and contains about 45 % total phosphates.

The trials with varieties of wheat showed "Queen Wilhelmina" to be the most prolific winter wheat for general cultivation, but the variety is very susceptible to yellow rust. Yeoman wheat is superior in milling quality, strength of straw and rust resistance.

The oat trials showed Victory II to be the most prolific variety, but as regards strength of straw and resistance to lodging it is inferior to Banner, Black Tartary 2, and Record. Black Bell III, a black oat, has proved to be very prolific, produces a long and fairly stiff straw and ripens early. Both varieties are pure line selections from Svalöf.

W. S. G.

158. Effect on Nodule-Formation and Seed Production of Growing Soybeans on Soil treated with Sulphur Dioxide.

LEONARD T. L. and NEWCOMER S. H. *Jnl. of American Society of Agronomy*, Vol. 17, No. 6, pp. 309-312. Geneva, N. Y., 1925.

Treatment of field soil with sulphur dioxide and formaldehyde in 1 % concentration showed that nodule formation was inhibited on the upper parts of the roots of Peking soybeans. "Sulphorm", a combination of the two above-mentioned substances, applied in the same concentration, did not inhibit nodule formation to the same extent.

No beneficial effects were noticed in the crops, except with Sulphorm, which gave 20 % more seed than the average of three controls.

W. S. G.

159. The Action of Dilute Sulphuric Acid on Cornfields.

RABATÉ E. Action de l'acide sulfurique dilué dans les champs de céréales. *C. R. de l'Académie des sciences*, Vol. 179, No. 22, pp. 1285-1287, Paris, 1924.

Dilute sulphuric acid sprayed on the soil rapidly attacks the mineral constituents, producing sulphates which, in dry weather, appear on the soil as a white powder. It increases the hydrogen-ion concentration, but colloidal clay minimises the sharp variations of acidity. The action is energetic and results in an increased yield which will not fall off if the sprayings are made on dry soil, or during drought. On plants it has a de-

hydrating, but not toxic action, proportionately stronger when the plant is young and during dry, warm, bright weather.

Experiments have been made of spraying 1000 litres of 10 % solution of sulphuric acid of 65° Baumé, per hectare ; the sprayings were made in December-January in the warmer parts (Italy, Provence) and in March-April in the cooler areas (Touraine, Beauce). In these conditions various herbaceous plants are killed immediately (ranunculus, matricaria, medicago); others (poppy, vetches, vetchlings, cornflower) are only killed with a 12% solution ; some plants (rye-grass, wild oat, garlic, grape-hyacinths) are resistent to the treatment.

In fields of oats and spring barley, the application of a 4 % solution is sufficient to kill *sinapis* ; the time recommended for Central France is about the second fortnight of April.

Cereals with smooth erect leaves, covered with cutin, with the ears still covered, are slightly scorched and bleached by the acid, but eventually produce strong stems and full ears, slightly late in reaching maturity. Sulphuric acid is also useful against cuscuta, mosses, algae and especially against certain fungi, such as *Leptosphaeria herpotrichoides* and *Ophiobolus graminis*.

It is always advisable to make a preliminary experiment on a plot of ground in order to ascertain the most suitable dose ; the result is apparent in a few days.

A. F.

Agricultural Botany, Chemistry and Physiology of Plants.

160. Bacteriophagi in the Nodules of Leguminous Plants.

GERRETSEN F. C., GRIJNS A., SACK J. and SÖHNGEN H. L. (Rijkslandbouwproefstation Groningen). Het voorkomen van een bacteriophag in de wortelknolletjes der Leguminosen. *Verslagen van Landbouwkundige onderzoekingen der Rijkslandbouwproefstation*, No. XXIX, pp. 1-6, 3 fig. The Hague, 1924.

Bacteriophagi have been isolated from the root nodules of clover, lupines and serradella ; this statement may explain the fact that inside such nodules the bacteria may disappear. These bacteriophagi appear to be specific in their action in respect to the bacteria which form the root nodules of the leguminous plants mentioned.

In addition to the nodules, the bacteriophagi have also been isolated from the roots and the stalk, but not from the leaves. They have also been isolated from garden soil and that of fields but not from that of woods and heaths.

These bacteriophagi withstand a temperature of 60° to 65° C. for 15 minutes, are resistant to drying and pass through thin collodion membranes. Their resistance to the ultra-violet rays is at least eight times greater than that of the relative bacteria.

A. F.

161. **The Age-Area Hypothesis in the Study of Flora.**

GREENMAN J. N. (Missouri Botanical Garden). *American Journal of Botany*, Vol. XII, No. 3, pp. 189-193, 1 map. Lancaster Pa, 1925.

The age-area hypothesis may have considerable importance in the study of flora, inasmuch as it simplifies many problems of botanical geography in the determination of the phylogenetic relations and in the evolution of groups of plants. This hypothesis assumes that the area occupied by a species depends on the age and, vice-versa, the age of a species is proportional to its geographical area. In other words, the area occupied in a given time, in a given country, by a group of allied species (not less than 10 in number) depends, principally — under approximately constant conditions — on the age of the species of this group in the country, such area however may become profoundly modified by the presence of barriers such as lakes, rivers, mountains, by changes of climate, by the action of man and by other ecological factors.

The present paper relates to the three divisions of the genus *Senecio*: Convolvuloideae, Streptothamni, Fruticosi. Each of these groups has a geographical distribution which, in South America, is extended in a continuous series in longitudinal direction (N-S). There has been a rapid migration northwards by these three groups, a migration which is extended along two lines towards Mexico and Cuba.

In the same group the species show a more or less definite relation between the area occupied and the age of the species themselves. This is evidenced by the greater stability of the morphological characters of the species which occupy large areas compared with those which are found over a limited area.

The species of the three groups considered are more or less woody; the greater part of them are of recent origin compared with other species of the same groups or with woody plants of allied groups. The origin of the respective species is not to be attributed to great changes but rather to natural selection which has been confirmed in the course of the relatively rapid migration northwards. Large and small changes may have occurred, but they constitute a factor of relatively small importance.

This article recognises that Willis' age-area hypothesis is fruitful and calculated to stimulate interest in the study of botanical geography.

A. F.

162. **The Problem of the Constitution of Starch.**

PHILIA M. Contributions au problème de l'amidon. *Bull. de la Société botanique de Genève*, II Ser., Vol. XVI, pp. 519-553. Geneva, 1924.

The investigations of the author show that starches derived from various plants have different constitutions. If, by means of the iodine reaction, the process of depolymerisation with amylase of barley is followed, it is observed that the starches of *Solanum* and arrowroot give a rapid liquefaction with pure blue coloration, while rice and wheat starches give an old-rose or rose-purple coloration. In the former case there is up to

the end an excess of amylase which determines the permanence of the blue colour, while in the latter the preponderant amylo-pectin imposes its own specific colourability. This specific character is maintained if, instead of using the starch solution, the false solution of the corresponding so-called soluble starch is used, though in that case the amylo-pectin has disappeared. The specific colourability, in the second case, is not due to the possibility of providing a pectin (gelatin form), but to the existence of a fundamental aggregation of polysaccharides which are coloured rose-purple by the iodine. It is also maintained by using reagents (lime, chloride of calcium, caustic soda, etc.) which tend to bring about a tautomerisation of the polymerised colloidal complex masses.

If the chemists finally agree regarding the nature of the fundamental body, or bodies, which constitute the starches, the biologist must consider the manner and degree of polymerisation of the two categories:— amyloses and amylo-pectins which determine the specific character of the starches and of the substances which form the basis of such specific character.

The writer has also studied the phenomenon of the fixation of the amylase (AMBARD's phenomenon), in which the granules of starch mixed with a liquid containing amylase almost entirely fix the latter and the new complex:— crude starch + amylase — shows such stability that the ferment (defixation) cannot be regained without the recurrence of starch paste, glycogen or dextrin.

The author's experiments do not fully correspond with those of AMBARD, as the former only obtained partial fixation of the amylase. The starches, then, do not all behave in the same way; thus wheat and potato starches fix the amylase of barley, while those of rice, beans, arrowroot, and barley do not fix it.

Various conditions, then, influence fixation, such as the concentration of the amylases, the reaction of the medium (an acid reaction is more favourable); the presence of phosphates and glycocoll (the former act in a more favourable sense than the latter).

An important observation is that fixation is checked by citrates and oxalates in the process of coagulation by enzymes.

A. F.

163. **The Significance of Copper, Manganese and Zinc in Forage Crops and Foods.**

MC HARGUE J. S. *Journal of American Society of Agronomy*, Vol. XVII, No. 6, pp. 365-327. Geneva, N. Y., 1924.

The object of the article is to present data showing the occurrence and proportion of copper, iron, manganese and zinc in certain plant products and to draw attention to their significance.

Fertile soils contain small amounts of copper, manganese and zinc, which are absorbed to a slight extent by plants and stored in the leaves, pericarps and germs of the seeds. When maize, wheat and rice are highly milled, the resulting meal, flour and polished rice are deprived

of the greater part of the compounds of copper, iron, manganese and zinc, which appear to be factors in animal nutrition. Some depleted soils may require the addition of small amounts of copper, manganese and zinc in order to restore and maintain productivity and to produce a food supply containing the vital factors in normal proportion. W. S. G.

164. **The Importance of Iron for Plants.**

MARSH R. P. and SHIVE J. W. (New Jersey Agricultural Experiment Station). *The Botanical Gazette*, Vol. LXXIX, No. 1, pp. 1-28, bibl., 2 fig. Chicago, 1925.

The work of the authors was done with the object of elucidating the relations between the iron content and the conditions of the plant (normal, chlorotic, toxic). A small quantity of iron, uniformly distributed, seems necessary for the health of the plant. The iron should be in the lowest concentration possible and scarcely greater than that which causes chlorosis owing to insufficiency of iron. When the concentration is greater, either toxicity is caused owing to the content being too high throughout the plant, or else chlorosis, because the iron is localised in the roots and stem and is unable to reach the leaves in sufficient concentration for the adequate formation of chlorophyll. To obtain a uniform distribution of the iron it is necessary to make frequent small additions, taking the state of the plant into consideration; the addition of iron at stated intervals, previously arranged, is not recommended because the requirements of the plant in iron vary according to the stage of its development. The determination of the balance of iron is very delicate, inasmuch as the plant requires that the iron should be within very narrow limits of concentration in order to produce satisfactory growth. A. F.

165. **The Constituents of the Sap of the Vine.**

WORMALL A. (Department of Physiology and Biochemistry, Univ. of Leeds). *The Biochemical Journal*, Vol. XVIII, No. 6, pp. 1187-1202, 1 fig., bibl. London, 1924.

The sap obtained from a vine which "weeps" is a dilute solution of organic and inorganic substances, containing 1.56 gm. of solid matter per litre, of which about one-third is inorganic matter.

The organic constituents are principally :— sugars (glucose, fructose and a very small quantity of saccharose) and organic acids (oxalic, tartaric, malic and succinic); the amount of the latter exceeds that of the sugars.

The mineral salts consist of :— chlorides, sulphates, nitrites, nitrates, silicates and phosphates of sodium, potassium, calcium, iron, magnesium and, in smaller quantities, of manganese and aluminium.

A very small quantity only of organic nitrogen is found, probably contained in the enzymes; the remainder of the nitrogen is in the form of nitrites and nitrates, though possibly there may also be some as amino-acids.

In the concentrated sap no trace can be found of lipin. A substance similar to fats was isolated, but in such a small quantity that it could not be identified; it was probably a mixture of neutral fat and free fatty acid. In the sap enzymes were also found diastase, peroxidase, and a small quantity of catalase; on the other hand, maltase, invertase, lipase, protease, glycerophosphates and renin were absent. A. F.

166. **Relation of Salt Concentration of Culture Solution to Transpiration and Root Respiration.**

NEWTON J. D. *Scientific Agriculture*, Vol. V, No. 10, pp. 318-320. Ottawa, 1925.

The author's experiments showed that the rate of plant root respiration, as related to transpiration, is increased when the salt concentration of the culture solution is increased. This indicates that as the concentration of the solution is increased, the plant must expend more energy in absorbing a given volume of solution.

The concentration of the soil solution is one of the factors governing water requirements of crops, and this concentration may be modified to some extent by cultural and manurial treatments. W. S. G.

167. **The Influence of Nitrites on the Growth of Plants.**

FEHER D. and VAGI I. (Botan. Inst. der Kgl. ungar. Hochschule in Sopron). Untersuchungen über die Einwirkung von Nitriten auf das Wachstum der Pflanze. *Biochemische Zeitschrift*, Vol. CLIII, No. 1-2, pp. 156-158. Berlin, 1924.

Some Hungarian alkaline soils contain a certain quantity of nitrites corresponding to 0.000 05 %. From the authors' researches, it appears that quantities even a thousand times greater are not prejudicial to vegetation, inasmuch as no toxic symptoms were observed four weeks after the addition of over one gramme of $NaNO_2$ for each kg. of soil.

The presence of traces of nitrites in soil can therefore have no influence on plant growth. A. F.

168. **The Effects of the Injection of Various Substances on Plants.**

NICOLAU G. "Actiunea injectarei diferitelor substante la plante", *Buletinul Agriculturei*, Vol. IV, Nos. 10-12, pp. 67-80. Bucharest, October-December 1924.

The author gives an interesting account of experiments, made over four years, on plants in all stages of growth from March to October grown in experimental plots of the Agricultural College of Cluj (Transylvania).

Having studied the effects of numerous injections made in men and animals, the author's object was to ascertain the results of injections of various substances on plants.

Ten plants having swollen tubular stems and leaves, namely: —

Allium Cepa, Taraxacum officinale, Urtica dioica, Lamium album, Conium maculatum, Chairatus marrubiastrum, Sonchus arvensis, Cucurbita Pepo, etc., were chosen for the experiment.

The results obtained were that almost all the solutions were absorbed and circulated in the organism of the plant. Certain substances, such as glucose, were assimilated, by the plant, as food; other substances poisoned the plant, such as sulphates of copper, zinc, chloride of sodium, etc. The author points out that all depends on the dose and the concentration of the substance introduced, on its density and also on the age of the plant. For instance it has been found that nitrate of potassium injected into an onion plant or other plant, has a plasmolysing effect, while if injected in concentrated solution and in large doses, this salt has a toxic effect. The ions of copper have generally a toxic effect on plants, especially on adult plants, sulphate of zinc is also toxic. It was found by experiment that adult plants are a thousand times more resistant to poisoning with copper salts than is the case with germinating plants. Glucose, galactose and other sugars, not only have no toxic effect, but form suitable food material.

It was generally observed that the plants behaved absolutely like animals as regards the substances introduced into their organisms. Only in the case when the solution acts in a reflex manner on the nervous system is the resistance of the plants to poisoning much greater than that of animals, plants being unprovided with a nervous system.

In conclusion the author shows that with the adoption of this experimental method in the vegetable kingdom, two benefits would result — one in the theoretical scientific field and the other in the field of practical application. From the former standpoint the author remarks — " I believe that plant physiology may obtain great benefit, because many phenomena may find new explanations. In agricultural science a number of capital questions may be cleared up by the application of this method, as, for example, that of " catalytic manuring " and mention is made in this connection of GABRIEL BERTRAND's experiments and theory.

L. L.

169. **Catalase in the Germination of Rice.**

MORINAGA TOSHITARO (Kyushu Imperial University Fukuoka). *The Botanical Gazette*, Vol. LXXIX, No. 1, pp. 73-84, bibl. Chicago, 1925.

The amount of catalase in dry rice is much less than that found in wheat, barley, oats, rye, of which, at most, it forms one tenth. When however rice germinates aërobically, an amount of catalase is found which is about seven tenths of that in wheat, barley, oats.

During anaërobic germination catalase does not increase; its formation is also reduced when germination takes place in a medium which contains a reduced amount of oxygen; it is inferred therefore that the proportionate increase of catalase activity is a function of the free oxygen in the medium. The free oxygen acts directly and indirectly on the development of the plumule and the radicle and also on the chlorophyll.

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The seedlings which have grown aërobically and contain much catalase, consume greater quantities of oxygen than those which are grown anaërobically with low catalase activity. The latter give off a relatively larger amount of carbonic acid gas. A. F.

170. **Hydrogen-Ion Concentration and the Development of the Pollen Tubes of *Lathyrus odoratus*.**

BRINKS R. A. (Agricultural Experiment Station, University of Wisconsin). *American Journal of Botany*, Vol. XII, No. 3, pp. 149-162, 4 fig., bibl. Lancaster, Pa., 1925.

It is known that pollen can germinate in artificial conditions on agar containing sterile saccharose and saccharomycetes.

In such circumstances, it is observed that the nuclei are situated in such a position that fertilisation may take place. These observations have particular importance because, the first factors of sexual reproduction being known, it may be hoped to arrive at a better knowledge of the process of reproduction and thus of certain problems relating to genetics. In his experiments, the author has taken care to prevent the toxic effect of the cations K and Na, which are introduced into the growth in the adjustment of the P_H. The maximum germination percentage is obtained with P_H 7.0, although the percentages obtained with P_H 6.0 and 8.0 are not much lower. It seems probable that, within these limits, the optimum hydrogen-ion concentration for germination is not clearly fixed.

The P_H zone favourable for the development of the pollen tubes, is relatively narrow. The optimum is about 6.0, while above and below that point development decreases rapidly. It should be emphasised that for germination there is considerable tolerance with regard to pH, while for subsequent development there is a restricted tolerance. It is not improbable that the hydrogen-ion concentration may modify the development of the pollen-tubes by a direct effect on the chemical reactions connected with the digestion of reserve materials.

In these experiments, the author has noted that, even when the known variables are accurately controlled, variations in the germination and in the development of the pollen are so considerable that it is necessary to make use of great numbers and to repeat the experiments in order to represent the facts statistically with a close approximation to accuracy.

A. F.

Plant Genetics.

171. **Crossings of Varieties of Maize.**

KOCH L. and SCHREUDER W. Vergelijnksproef van Maisbastaarden. Extract from *Algemeen Landbouwweekblad voor Nederl.-Indië*, 1. halfyear, pp. 2-11. Bandoeng, 1924.

Crossings of three varieties of maize (Saipan Corn, Yellow Menado and White St. Croix) have given favourable results; crosses were made between the first and each of the other two.

The yield of grain exceeded by 40-50 % that of the parents ; there was less tendency to lodging ; a larger yield of leaves and stalks was obtained ; the seed is less subject to mould (*Aspergillus* sp.). A. F.

172. The Division of the Root and the Production of Seed in the Turnip.

PASSERINI N. Sopra la influenza della divisione della radice di « Brassica rapa L. » sulla produzione del seme. *Bollettino della Società botanica italiana*, No. I, pp. 6-10. Florence, 1925.

Division of the root was, together with grafting and multiplication by buds, adopted with the object of increasing the production of seed in selected varieties of sugar beet.

The author has made similar experiments, observing that mutilation of the roots caused the loss of a certain number of individuals, a loss which became greatest (over $^1/_5$) with the division of the roots into four quarters. The *total weight* of seed produced on three experimental plots, in which had been placed entire roots, roots cut in two and roots cut in four, remained approximately equal, which shows that division would have caused an increase if the serious mutilation had not occasioned the loss of about $^1/_5$ of the plants.

Mutilation considerably lowered the average yield per unit production of seed of plants thus grown and rather more with division in four than with division in two. Notwithstanding this, the production of seed in some cases exceeded the average of plants grown in normal conditions and actually in 13 % of the plants divided in two and in 4 % of those divided in four. Mutilation was likewise the cause of lowering the average weight of the seeds, which was proportionally greater according to the degree of mutilation. A. F.

173. The Chromosomes in *Saccharum*.

BREMER G. (Plantkundige aan het proefstation). De chromosomen bij primitieve vormen van het geslacht Saccharum. *Archief voor de suikerindustrie in Nerderlandsch-Indië*, No. 16, pp. 477-508, 20 figs. Soerabaya, 1924

In the Andropogoneae and in the Maydeae the chromosomes are 10 in number or a multiple of 10 and also in the genus *Saccharum* they are often found as a multiple of 10.

It is probable that originally the number of chromosomes in this genus was 10 and that from it have been derived the present species with a larger number of chromosomes. A. F.

174. Report on Five New Hybrid Varieties of Tobacco.

GUTIERREZ M. E. *Philippine Agricultural Review*, Vol. XVII, pp. 263-260, plates 6. Manila, 1924.

The object of the hybridisation work was to obtain a combination of desirable wrapper leaf characters by crossing the Pikit Station

varieties with introduced varieties. The five hybrids obtained have advantages over their parents in luxuriance, vigor, earliness, size of leaf and rapidity of growth.

The author supplies botanical details of each hybrid. The article is illustrated by excellent photographic reproductions. W. S. G.

CROPS IN TEMPERATE AND TROPICAL COUNTRIES

(INCLUDING FORESTRY).

175. Influence of Spacing between Plants on the Yield of Maize.

SCHREUDER W. Uitkomsten van een plantverbandproef met gele Menado mais. Extract from *Algemeen Landbouwweekblad voor Nederd.-Indie*, 1 half-year, pp. 1-9. Bandoeng, 1924.

Experiments in spacing made by sowing the "Menado" variety of maize in furrows 3 feet apart and at distances respectively of 3, 2 ½, 2, 1 ½ feet. The spacing 3 ft. × 2 ft. gave the best results, as regards dry grain, in proportion to area. The yield of dry grain for each stool was proportionally greater with the wider spacing of the plants. The total number of stools per unit of area was of course greater with the narrower spacing, but the average weight of each plant, was, on the contrary, proportionally less. With the wider spacings the stems each formed two or even three tillers; with spacings narrower than 2 ½ feet each stem formed only one tiller. As a rule the *Menado* variety has only one tiller, but may have more under good conditions. With spacings narrower than 2 feet the plants lodged. A. F.

176. A Valuable Swamp Grass.

AUDAS J. W. *Journal of the Department of Agriculture*, Victoria, Vol. XXIII, Part. 6, pp. 366-369. Melbourne, 1925

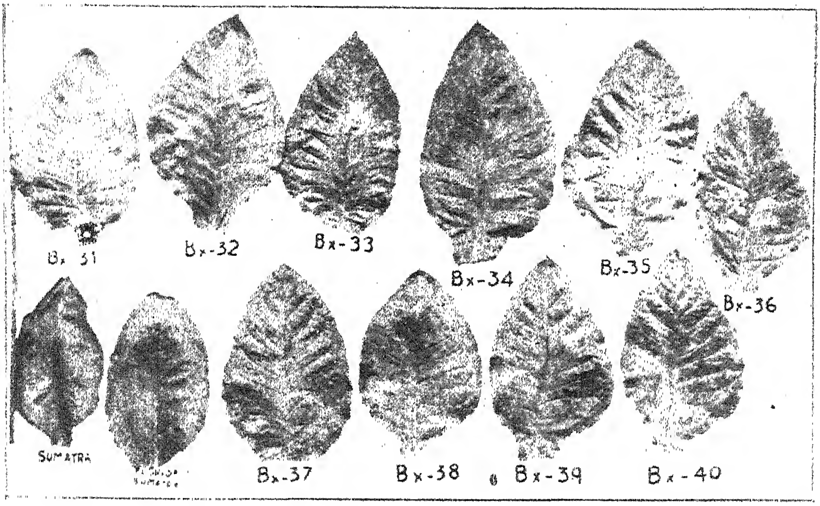
Indigenous swamp plants are generally of low nutritive value, and certain grasses that have been introduced to replace them have not proved strong enough to overcome the local growth.

The plant *Glyceria aquatica*, Wahlemb, "Water Spear Grass or Reed Meadow Grass", however, has been tried in various parts of Australia, with satisfactory results.

Fodder may be obtained from these plants during eight or nine months of the year, and as much as 50 tons of green fodder per acre have been cut.

As regards protein contents, *Glyceria aquatica* contains 7.67 %, as compared with Japanese Millet 6.43 %, and *Paspalum dilatatum* 6.31 %. The grass is relished by all kinds of stock. W. S. G.

PLATE XIII.



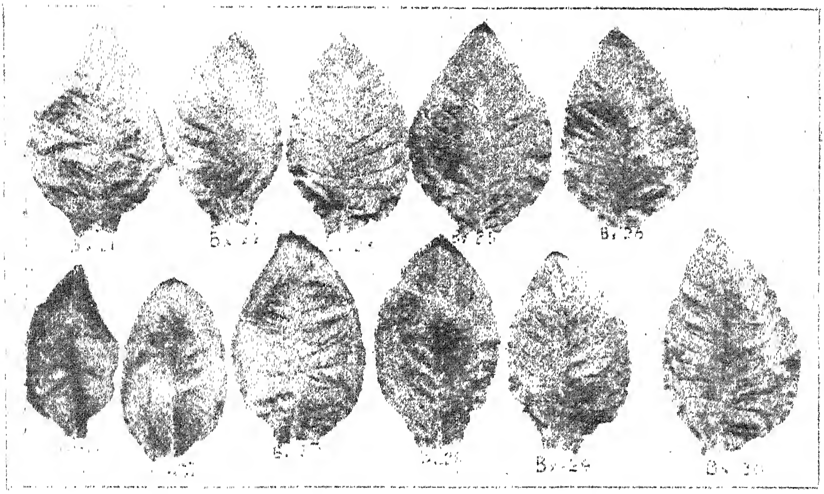


FIG 55 and 56. — Shapes of leaves of the different strains of the Florida-Sumatra × Baker's Sumatra.

177. **Production of Long Stapled Cotton in India.**

KOTTUR G. L. (Cotton Breeder, Dharwar.). *Agricultural Journal of India*, Vol. XX, Part III, pp. 195-199. Calcutta, 1925.

There is a great shortage of long stapled cotton, and an increase of 100,000 bales of this type is more important to the world than 1,000,000 bales of short stapled cotton below $^7/_8$ inch.

The great bulk of the Indian crop is of decidedly short staple, and the Indian mills consume nearly 80 % of the good cotton produced.

Kumpta cotton, of medium staple, gives only 25 % of lint on ginning, but was found to contain higher ginning strains, and by isolating one of them, the percentage has been raised to 28 %, an important increase in yield obtained without change in any methods of cultivation.

Two pure strains, were crossed, one of Kumpta with a ginning percentage of 28 and a long staple (1 inch), and another of *neglectum rosea* with a ginning percentage of 36 and a staple of ½ inch. After five years selection pure strains have been obtained combining the desired characters of both parents ; the strains will shortly be issued to replace Kumpta cotton.

In all probability, a staple of one inch is the limit for Indian cottons, and the ideal should be to breed types with a ginning percentage of 45 and a staple of 1 inch, suitable for cultivation in different areas.

The Dharwar-American cotton contains both hairy and glabrous plants ; by isolating a superior strain of the hairy type, the yield and quality have been improved and the cultivation area extended. Cambodia cotton was at one time yielding cotton of staple longer than one inch.

The author is of opinion that the breeding of American cotton has good prospects for the production of long staple.

First generation hybrids are often very profitable ; a cross between Dharwar-American and Sea-Island produced the same quantity of lint as the former, but of the Sea-Island quality. The chief difficulty, however, is to obtain sufficient seed every year for sowing.

Tree cotton produces long staple, and there is a considerable area of the heavy rainfall tract of Bombay suitable for this type, but tree cottons cross freely in the field and pure seed is very difficult to obtain. The first generation hybrid between two pure varieties such as Kidney and Peruvian is profitable. W. S. G.

178. **Tanning Materials from Travancore.**

Bulletin of the Imperial Institute, Vol. XXIII, No. 2, pp. 158-168. London, 1925.

The following barks were forwarded for investigation : —

(1) " Elengi " (*Mimusops Elengi*, Linn.) ;
(2) " Perzhu " (*Careya arborea*, Roxb.) ;
(3) " Mora " or " Munga Perzhu " (*Buchanania latifolia*, Roxb.) ;
(4) " Vaga " (*Albizzia Lebbek*, Benth.) ;
(5) " Karlencha " (*Acacia pennata*, Willd.) ;

(6) " Thambagom " (*Hopea parviflora*, Bedd.) ;
(7) " Venga " (*Pterocarpus Marsupium*, Roxb) ;
(8) " Thembavu " (*Terminalia tomentosa*, Bedd.).

The results of the investigation showed that none of the eight samples represented bark which could be profitably exported to Europe as a tanning material.

Although containing too little tannin to be worth exporting, the *Hopea parviflora* bark (No. 6) is a promising material for extract manufacture, and should yield a solid extract containing 50 % of tannin. *Terminalia tomentosa* bark (No 8) should yield a product similar in quality to mangrove extract. W. S. G.

179. **Lac in Indo-China.**

CREVOST Ch. " Catalogue des Produits de l'Indochine ", *Bulletin économique de l'Indochine*, Year XXVIII, 1925-II, No. 171, pp. 191-205, 3 fig. Hanoi, 1925.

The author continuing the publication of the " Catalogue of the Products of Indo-China " deals here with stick-lac in Indo-China.

The area of production of stick-lac is very extensive ; the principal centres of production are as follows : —

In Tonkin, the provinces of Son-la (Châus of Son-la, May-son) and Hoa-binh (districts of Van-yên and Van-bu), the 4th Military district (Chaus of Lai-châu ; Luan-châu ; Diên-biên-Phu ; Tuan-giao) ; Cho-ho is the principal market. In North Annam, the high regions of Nghê-an and Thanh-hoa backing on the Laos frontiers. In Laos, the provinces of Houa-Phans (Munnga of Samneua, Muong-het, Sam-teu, Muong-son), Tranninh, Vien-tiane, Haut-Mékong (Ban-houei-sai), Saravane, Bassac (Khong), Strung-treng, etc. In Cambodia, the regions of Kompong-speu, Kompong-thom, Pursat, Takeo, Khets of Treang, Bati, Preykrebas.

In Cochin-China, the province of Taguinh, to a small extent, and the provinces of Rach-gia and Soc-trang with a crop of some importance recently started. The plants on which the colonies of *Tachardia lacca* R. Bld. live are very numerous and belong to various families, some laticiferous, others without secretions.

It is claimed that the products are different according to the trees on which the insects live, altough there may be various species.

A distinction should be made between plants cultivated as lac-bearers and species forming naturally hosts for the *Tachardia*, both of which yield two annual crops, the first in September and October, the more important, and the second less in quantity, in March and April, limited by conditions of altitude.

The plants cultivated as lac-bearers are as follows: — *Cajanus indicus* Spreng. — *Combretum quadrangulare* Kurz. — *Dalbergia nigrescens* Kurz. — *D. Kerrii* Craib. — *D. hupeana* var. *laccifera* Eberhardt and Dubard. — *Schleichera trijuga* Wild. — " Pik-nieng " (undetermined species of Laos). Wild plants naturally lac-bearers are as follows. — *Ficus religiosa* L. — *F. indica* L. — *Butea frondosa* Roxb. — *Shorea cochinchinensis* Pierre. — *Feronia elephantum* Corr. — *Nephelium Litchi* Camb.

The author deals with the swarming and the crop, then with the industry of the product. The natives of Indo-China seldom make use of stick-lac now. Before the introduction of aniline dyes they used the colouring matter " Lac-dye " for dyeing materials red or violet with a mixture of indigo. They continue to use only small quantities of stick-lac in conjunction with other materials for lacquering teeth, for fixing tools in their sockets and for preserving farming implements against rust a layer of stick-lac being applied hot. Indo-Chinese stick-lac is therefore exported outside the Colony. The trade exports are as follows :—

(1) Through Haiphong (Tonkin) for Tonkinese production and that of North Laos.

(2) Through Saigon (Cochin-China) for Cambodian production and that of South Laos.

(3) Through various ports of Annam for the production of Annam and the neighbouring lac producing regions.

The following statement shows the figures of stick-lac exports from 1914 to 1924 :—

1914	206,500 kg.
1915	64,600
1916	135.200
1917	95,500
1918	84,200
1919	762,800
1920	955,800
1921	444,700
1922	1,232,100
1923	1,177,100
1924	6,347,500
Total	6,347,500 kg.
Average	577,000 kg.

The distribution of exports for the year 1924 was :—

Cochin-China	636,600 kg.
Tonkin	544,600
Cambodia direct	4,800
	1,186,000 kg.

In addition, as the result of a refining process, the following quantities of " shell-lac " have been exported through Tonkin :—

1917	3,000 kg.
1918	—
1919	200
1920	—
1921	—
1922	1,200
1923	5,800

Lastly, Cochin-China has been able to export the following quantities of shell-lac:—

1920	29,500 kg.
1921	10,000
1922	—
1923	23,500 kg.

At Hanoi the market price for stick-lac in July 1924 was 100$ per 100 Kg.

At Saigon, at the same date, stick-lac was quoted at between 120 and 140$ per 100 kg. P. C.

(*Correspondent Indo-China*).

180. **Manuring of *Hevea brasiliensis*.**

SPRING F. G. *Malayan Agricultural Journal*, Vol. XIII, No. 5, pp. 145-145. Kuala Lumpur, 1925.

A system of manuring for annual crops is easily determined, but such is not the case with permanent crops like rubber, where the influence of fertilisers on later yield is still problematical.

The high temperature, humidity or heavy rainfall of Malaya, cause more rapid decomposition of substances in the soil than occurs in temperate zones and plant food is rendered more rapidly available.

Attention is drawn to the work of other investigators, and to experiments carried out in Ceylon, Malaya, South India and Sumatra, the results of which do not indicate that the application of artificial fertilisers will be an economic proposition in respect of increased yields of latex, except under certain circumstances. W. S. G.

181. **Anomalies in Sugar Beet.**

MORI G. Anomalie riscontrate sulle bietole da zuchero coltivate nel 1924. A pamphlet of 22 pages, with 13 fig. Genoa, 1925.

Beet growing in 1924 was characterised by the rainy conditions of the summer, low temperatures and by the consequent abundant but poor quality yield. Among the anomalies frequently noticed may be mentioned the "colletto ad ananasso" (French "*cul de bœuf*"), caused by various unfavourable circumstances, such as:—

(1) prolonged coldness of the soil and excess of moisture;

(2) uneven distribution of the plants and especially isolated plants which have in consequence abnormal growth;

(3) intense attack by *Cercospora* favoured also by late sowing and the consequent immaturity of the roots and foliage.

Another anomaly frequently observed was the strong development of surface roots and the production of rootlets. This result is partly due to the humidity of the soil and also to badly executed thinning of the beet plants. Everything should be done to prevent the formation of these

surface roots, which give a very inferior product, a large proportion of which will be thrown away before it reaches the factory. It will also be necessary for manufacturers and growers to come to an agreement in order to avoid the first losses due to an inferior product and they should therefore arrange for a minimum diameter of the roots ; such a limit has been fixed in some cases at 10 mm., so that roots which pass through a 10 mm. ring are considered as rejected.

A. F.

182. The Relation between Spacing and the Yield of Sugar Cane.

LOHR P. L. Het verband tusschen uistoeling en rietproduct. *Archief voor de suikerindustrie in Nederlandsch-Indië,* Year 32, No. 31, pp. 767-773. Soerabaja, 1924. — TENGWALL, T. A. *Idem, Ibidem,* pp. 773-786.

From experiments made in the open field, LOHR concludes that with diminished spacing between each cane plant the total weight per *bouw* (= 0.7096 ha.) is increased, though the weight of single canes generally is less. The influence of the spacing, in the same field and for the same variety of cane, is preponderant in relation to the yield in that plantation.

TENGWALL, on the basis of mathematical considerations, shows that no direct relation exists between the spacing and the weight of the cane since the weight of single canes also has an influence on the product. LOHR's conclusions do not admit of a generalisation which might lead to erroneous statements.

A. F.

183. The Burning of Sugar Cane to Facilitate Harvesting.

CROSS Dr. W. E. (Director, Agric. Exp. Station, Tucuman), *The Planter and Sugar Manufacturer*, Vol. LXXIV, No. 16, pp. 305-310, tables 4. New Orleans, La., 1925.

The burning of cane before harvesting leaves the stalks free from leaves and reduces the cost, as a labourer in Hawaii can cut three tons more per day than when the canes have to be stripped by hand.

The stalk is not burned, but the cells, and therefore the cane, is killed, and the cane in consequence is liable to decomposition. GEERLIGS found that if the burnt canes are milled at once, the juice is not much inferior to that of unburnt canes.

Results of experiments have shown definitely that the burnt cane is of good sucrose content and purity if harvested and milled within two or three days of burning ; hence, the area burned should not exceed what can be cut and milled within the above period.

Investigations are being continued at the Tucuman Station as deterioration is found to proceed slowly, as compared with results reported from tropical countries.

W. S. G.

184. **Quality of Cacao.**

WATTS Sir FRANCIS K. C. M. G., D. Sc. *Tropical Agriculture*, Vol. II, No. 8, pp. 172-174. Trinidad, 1925.

The qualities desired by manufacturers of cocoa or chocolate are plumpness of beans, readiness to fracture, good colour of interior of bean, a cinnamon colour being preferred to purple or dark colours, pleasant taste and aroma, and freedom from excessive bitterness.

It should be possible to modify the quality of the cacao by different methods of fermentation and drying, but certain varieties of cacao possess distinctive characteristics, and these are sought after by manufactures for specific purposes.

The lowest grade variety is the Calabacillo cacao, whose beans are harsh in flavour and not suited for fine g ades of cocoa or chocolate. The next grade is the Forastero cacao, which forms the main supply of the market; it has a more delicate flavour and is less harsh and bitter than Calabacillo. The most delicate flavoured is the Criollo variety, a native of Venezuela and the neighbouring parts of South America, and this cacao constitutes the standard for high quality cacao. The beans are round and the interior white, the flavour is delicate and free from bitterness. Unfortunately the tree is more delicate and susceptible to disease than either of the other types.

The introduction of the Criollo variety into other countries presents difficulties, as it has been found that cross pollination takes place with local varieties, with the result that the hybrids gradually revert to the local type.

To establish Criollo plantations successfully it would be necessary to proceed on a "community basis," as has been done in the case of pure strains of cotton. Only the one variety must be grown in a given district. To attain this object, legislative action would be necessary to prevent the planting of any other type than Criollo, and the destruction of trees of other types already in existence.

In Ecuador three varieties are grown, Arriba, Machala and Varanjal, all of which possess desirable and valuable aromatic flavours and are high grade cacaos. They are not grown in Trinidad on account of the danger of introducing certain diseases known to occur in Ecuador.

W. S. G.

185. **Growing Wrapper Tobacco in the Cotabato Valley, Mindanao.**

GUTIERREZ M. E. Superintendent, Pikit Tobacco Station. *Philippine Agricultural Review*, Vol. XVII, No. 4, pp. 227-236. Manila, 1924.

The author describes the climate, soil and methods of cultivation and handling of tobacco, employed in the Cotabato Valley, and then summarises the requisites for the successful production of wrapper tobacco, as follows:—

(1) A very rapid uninterrupted growth of the plants.

(2) Uniform stand of the crop in the field in order to provide the necessary intershading of the leaves.

(3) Planting at close distances for production of fine leaves.

(4) Absence of spots and specks caused by diseases and damage by worms and insects.

(5) Proper curing, and fermentation controlled by the thermometer.

(6) Careful classification of leaves into classes and grade.

(7) Careful attention to all details incident to production.

W. S. G.

186. **Banana Cultivation.**

DASH Prof. S. J. *Tropical Agriculture*, Vol. II, Nos. 7, pp. 144-147 ; No. 8, pp. 184-185. Trinidad, 1925.

The article covers the more important points of banana cultivation, the subject being treated under the following heads : History and commerce, botanical relationship and structure, varieties, soils and climate, propagation, preparation of land, time to plant and prune, after-treatment of land, harvesting, pests and diseases, returns.

The following figures relate to banana cultivation in Grenada : estimated cost over a three years period of cultivation, harvesting and transport, £ 42 per acre, which with an average yield of 750 bunches in the three years, at 2s. per bunch, give a gross return of £ 33 or £ 11 per acre per annum. W. S. G.

187. **Forest Fire Protection.**

TROUP Prof. R. S. (Director, Imperial Forestry Institute, Oxford). *Tropical Agriculture*, Vol. II, No. S. pp. 167-169. Trinidad, 1925.

In the paper the author indicates some of the more important points connected with forest fire protection ; the actual measures to be adopted in individual cases must depend on local conditions.

Forest fires constitute so great a menace to the welfare of the forest that fire protection may be regarded as an essential preliminary to successful forest management. In the great coniferous forests of British Columbia it has been said that for every tree utilised more than 20 trees are destroyed by fire.

Attention is drawn to the value of fire maps, which are useful for noting the increase or decrease of fires over a number of years, and also for showing in what parts of the forest they occur. In parts of North America and India, fire maps have shown that forest fires have originated most frequently near farms and village lands, which information is of use in indicating control measures. W. S. G.

ZOOTECHNICS.

188. The Partial Replacement of Hay by other Foods.

DE RUYTER DE WILDT J. C. and BROUWER, E. (Rijkslandbouwproefstation Hoorn). Onderzoek omtrent een gedeeltelijke vervangin van hooi door andere voedermiddelen. *Verslagen van landbouwkundige onderzoekingen der Rijkslandbouwproefstation*, No. XXIX, pp. 61-93, I fig. The Hague, 1924.

The authors have tested the effect of replacing about $^2/_3$ of the ration of hay by a mixed food of composed "Tarwegrint" (a milling by-product similar to bran) and maize meal with pea and oat straw. The test was made on the milk production of dairy cows.

The result of such replacement in a mixed diet was that no influence could be noticed either on the weight of the cows or on the quantity and composition of the milk. From calculations made, it is concluded that in the winter of 1922-1923, in a period of scarcity of hay, the above replacement caused a saving of 135 florins per 1000 kg. of live weight in a stall period of 180 days. A. F.

189. Seconds Bran for Feeding Pigs.

BRUWER E. (Rijkslandbouwproefstation Hoorn). Vergelijkend onderzoek omtrent de voederwaarde van tarwegries en tarwegrint bij varkens. *Verslagen van landbouwkundige onderzoeknigen der Rijkslandbouwproefstation*, No. XXIX, pp. 12-48. The Hague, 1924.

"Tarwegries" and "Tarwegrint" are by-products of fine milling of grain which may be considered as bran, or seconds. The percentage analysis is as follows:—

	Tarwegries	Tarwegrint
Crude protein	18.0	14.2
Pure protein	16.1	13.0
Pure digestible albumen	14.7	11.4
Nitrogen-free extract	51.6	50.7
Crude fat	4.8	3.9
Crude cellulose	7.7	10.8
Ash	4.5	5.2
Moisture	13.5	15.2

These products are not much liked by pigs. Their nutritive value, as appears from the writer's experiments, in less than that of barley or maize. A. F.

190. Report on Comparative Experiments with Pigs from State-aided Pig Breeding Centres.

LUND A., BECK N., ROSTINF P. — 13de Beretning om sammenlingnende Forsøg med Svin fra statsunderstøttede Avlscentre. 117de *Beretning fra For-*

søgslaboratoriet, udgivet af den Kgl. Veterinaer-og Landbohøjskoles Laboratorium for landøkonomiske Forsøg, pp. 146, plates, bibliography. Published by AUGUST BANG, Copenhagen, 1925.

The report describes investigations made during the period September, 1st 1923 to August, 31st 1924 at the three *Pig Experimental Stations: Bregentved, Elsesminde*, and *Over-Løjstrup*, the purpose of which was to study the fattening and butchering qualities of the pigs coming from the State-aided centres and fed at the stations.

In Denmark we find practically two breeds of pigs only; the Danish Country Breed and the Yorkshire Breed (the Large White). There are a number of breeding centres for each of these races in Denmark, the purpose of which is to produce pure-bred animals. The foundation of the centres, which goes back more than 30 years, is chiefly due to the influence of the Live-stock Commissioner, M. P. Mørkeberg.

The original reason for starting these centres was that Denmark almost forty years ago began to sell bacon to England. The type of pork existing in this country at the time did not possess the qualities demanded by the English bacon market, and to meet this difficulty, a search was made throughout the country for animals of the type in request. These animals were then brought to the *Breeding Centres*, which were in course of time able to distribute good breeding animals all over the country. The fact was, however, that a large percentage of the country bred pigs — at that time at any rate — suffered from such essential deficiencies (form, fineness) that it was much to be desired that breeding animals of better form should be used for breeding animals for the market. Consequently Yorkshire Breed centres were founded for producing boars, so as to procure — by crossing them with country sows — the real bacon pigs. As a far greater number of sows than of boars are required for breeding a considerably greater number of centres were established for the native breed than for the Yorkshire breed. The reason for not breeding exclusively from the Yorkshire is that this breed is considered to be too delicate for the Danish conditions. At present there are in Denmark 161 centres for the native breed and 33 for the Yorkshire breed. The centres must submit to an inspection on the part of the management, who select the animals fit for breeding; the centres obtain a very modest annual subsidy from the Government, and in return bind themselves to keep the necessary herd-books, mark the animals and deliver to the experiment station of the district two pigs every year of the sows chosen. In the course of the years (until the 1st of September 1924) a very great number of breeding animals came from the centres; 27 800 boars and 65 654 sows of the country breed, 10 237 boars and 4 478 sows of the Yorkshire breed were sold.

In estimating the value of the breeding animals selected, especially as regards the fattening and butchering qualities, great assistance is afforded by the figures from the experiment stations. It has been mentioned that the centres are bound to forward to these stations two pigs for each sow chosen; this is done by each separate centre for-

warding — after the best boars and sows — a certain number every year of *experimental batches*, consisting of 4 porkers, 6-8 weeks of age, of the same farrow and preferably 2 boars and 2 sow-pigs. Each of the stations, which are spread all over the country, may breed from 100-200 experimental batches every year. The same mode of proceeding is applied everywhere, only certain kinds of grain (barley, oats, wheat in proportion ½-¼-¼) and skim milk being used for feed. The feed is weighed out every day for each batch that has its own sty at the station ; every fortnight each pig is weighed and when the fattening is ended (the pigs on leaving have a live-weight of fully 90 kg.) the consumption of food which for each individual batch has been necessary to produce on an average 1 kg. of growth, is estimated in food units. The sufficiently fattened animals are taken to the slaughter-house and after the slaughtering, each animal is submitted to a competent judgement at which various measurements are taken (the depth of the belly, the length of the trunk) and marks are given for characteristics of form, fineness, fleshiness, etc. For 1923-24 the reports from the three experiment stations show the averages given in the table:

Averages for the Experiment Stations for the year 1923-24.

		Native Breed	Yorkshire Breed
Number of animals		1192	312
Age in days	at the beginning	60	63
	» » end	184	194
Weight in kilos	at the beginning	16.8	15.9
	» » end	92.1	91.6
Food units (kgs.) for 1 kg. growth during the time of the experiment		3.59	3.55
At the time of slaughtering	percentage of waste	26.9	25.4
	» » offals	12.6	12.6
	» » bacon for export	60.5	62.0
Thickness of the pork in cm.	the chine	4.2	4.1
	» belly	2.9	3.2
Length of trunk in cm. from hip-joint socket to neck		89.5	88.2
Points in (x) judging 0 — 15.	firmness of the pork	12.6	13.5
	thickness & evenness of the chine of pork	12.4	12.5
	thickness and fleshiness of the belly	11.5	12.2
	shape and size of the hams	11.9	12.4
	fineness of head, legs and skin	12.4	13.1
	fleshiness	12.2	12.4

(x) 15 = vg, 12 = mg, 9 = g.

The country bred pigs reached the slaughtering weight ten days before the Yorkshire pigs; the ratio of fatness f. u. to 1 kg. growth was excellent and alike for both breeds. The native breed was a little longer in the trunk, but as to quantity of export bacon and quality, the Yorkshire breed appears to be superior.

FARM ENGINEERING.

191. Experiments in Electro-Culture.

SMITH, F. Beretning om tre aars elektrokulturforsøk. *Meldinger fra Norges Landbrukshøiskole*, 1923, No. 6-7, pp. 353-536, 26 fig. Christiania, 1923.

The author refers to experiments in electro-culture made with barley, grown either in pots or in water.

In 1920, continuous electrification was maintained day and night, as a direct current from the apex to the roots with an intensity of 10^{-8} ampères. No action favourable or unfavourable was observed. No effect resulted from increasing the air current to double the normal.

In 1921, discontinuous electrification was used, given as direct cusrent of one minute duration, at intervals of 15 minutes and was cut off at night; the intensity was the same as in 1920. The effect was favourable on the plants. No result was obtained by increasing or decreasing the air current.

In 1922, an alternating current at intervals of half an hour for one minute duration, with an intensity of 10^{-6} ampères was employed but gave no result. No result was obtained even with direct current (10^{-6} ampères per plant) combined with an increased air current so strong that the tips of the leaves withered. A. F.

192. Tractor Ploughing for Padi Cultivation.

JACK H. W. *The Malayan Agricultural Journal*, Vol. XIII, No. 5, pp. 142-144. Kuala Lumpur, 1925.

The methods of the Malays in the cultivation of padi have been criticised as wasteful and antiquated, but are the results of practical experience.

The author discusses and compares the relative merits of buffalo ploughing and ploughing by tractor, his opinions being based on trials carried out with two well-known tractors.

As a result of investigation the author considers that tractors may have a future in the cultivation of large areas of padi, where the soils are fairly hard, and where irrigation is controlled, but that they are essentially for use by capitalists on large areas only, and their adoption is not probable in the near future. W. S. G.

193. Tests with a Rotary Tillage Cultivator on the Experiment Farm of the Agricultural High School, Vienna.

KASERER (Professor at the Agricultural High School, Vienna). Ein Fräsversuch zu Zuckerrüben auf der Versuchswirtschaft Gross-Enzersdorf. *Wiener Landwirtschaftlichen Zeitung*, No. 9, p. 69, part 4. Vienna, 1925.

A field which in 1923 grew potatoes was in the autumn ploughed to a depth of 15 cm. and, to remove any potatoes which might still

be left, then roughly harrowed. In December 1923, 200 quintals of stable manure per hectare were applied. On the 26 March 1924, 200 kg. of basic slag per hectare were applied. As the weather conditions were still very unfavourable — temperature very low and snow deep — a part of the field only could be ploughed to a depth of 20 cm., on April 19. The remainder was cultivated or cut to a depth of 15 cm. on April 26 with a 30 H. P. rotary tillage machine (frase) constructed by SIEMENS-SCHUCKERT. Both operations turned the manure into the soil.

The ploughed part of the field was then harrowed, a spiked roller was then used and again the harrow. The cut part of the field was also harrowed, so as to prepare it and bring it into a finer condition for planting.

On May 2 1924 the whole field was treated with a smooth roller. On the 3rd sugar-beet was planted at an average spacing of 42 cm. The further treatment of both parts was identical, except for the difference in nitrogenous manuring. One half of each experimental surface was treated with two dressings of Chile nitrate, of 200 kg. per hectare each, the other halves being given Leuna nitrate, two dressings of 120 kg. per hectare each. The amounts of nitrogen of each manure when calculated per unit surface were approximately the same.

The yields obtained are given below:

TABLE I. — *Manurial experiments on rotary tilled and ploughed land.*

Crop yields:	Manuring with Leuna nitrate		Manuring with Chile nitrate	
	rotary cut	ploughed	rotary cut	ploughed
Fresh crops in quintals per hectare:				
Beets	307	238	291	255
Leaves and tops	158	228	190	208
Sugar	17.75	16.50	15.76	16.32
Dry substance in % of green mass:				
Beets	23.17	22.05	21.41	23.06
Leaves and tops	16.69	15.46	13.25	13.24
Dry substance of the crop in quintals per hectare:				
Beets	58.33	41.95	47.18	42.53
Leaves and tops	26.88	35.18	26.34	27.55
Sugar	47.84	33.43	36.80	31.72

The results of the investigations on the physical conditions of the soil during the period of growing are given in Table II and were obtained by the Plant Cultivation Department.

It is seen that despite the abundant atmospheric precipitation of the summer, the humidity of the lower layers of the soil diminishes from the spring till autumn.

The first table shows that when arranged according to Chile and Leuna nitrate manure the cut field in each case gave a richer crop than the ploughed field. What strikes one most when looking through the figures in

PLATE XIV.

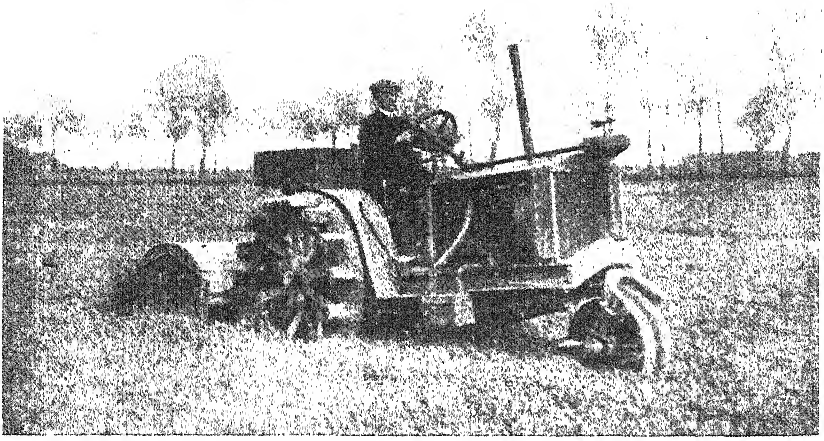


FIG. 57. — 30 HP soil rotary cutting machine.

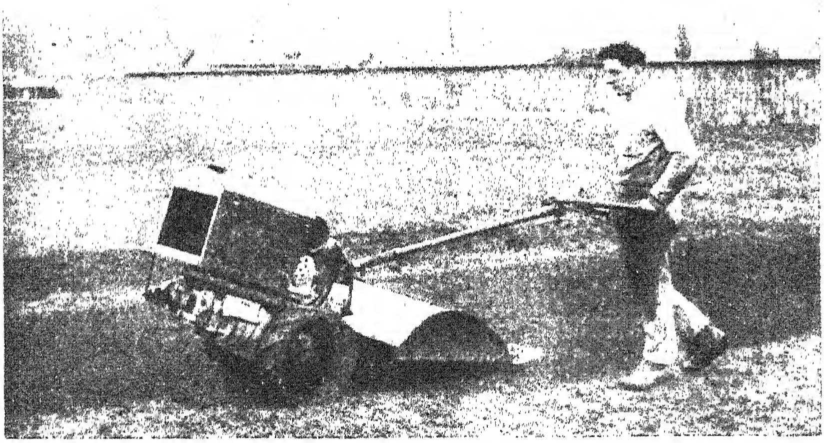


FIG. 58. — 8 HP « plantagen » soil cutting machine.

PLATE XV.

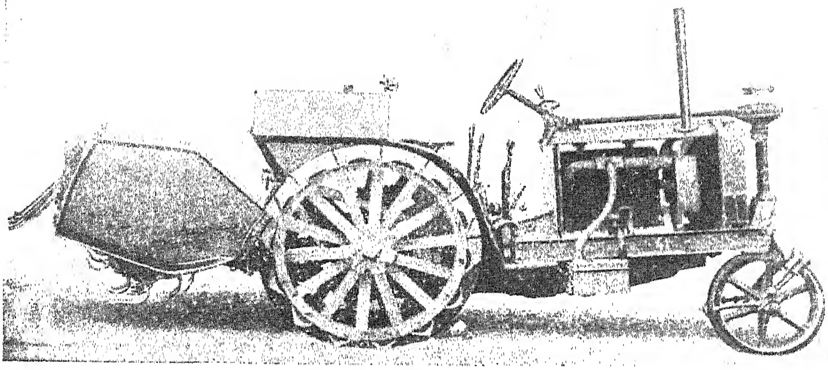


FIG. 59. — 30 HP. G. or goods machine.

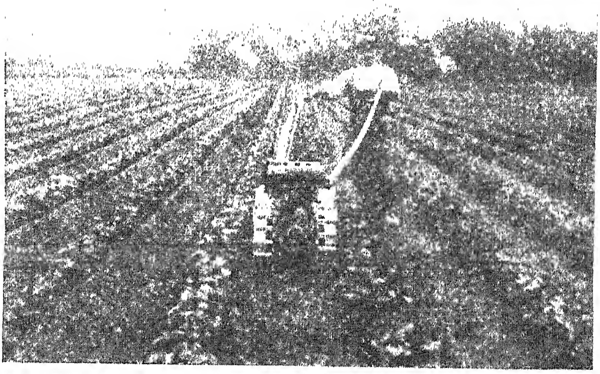


FIG. 60. — Garden machine with handles.

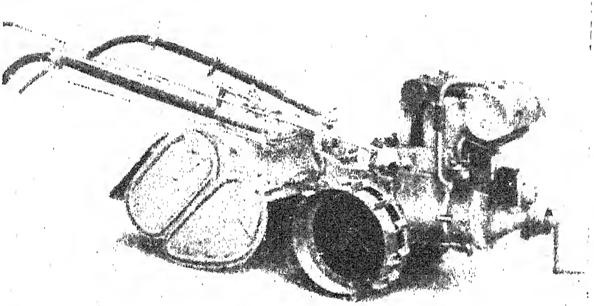


FIG. 61. — 4 HP. Garden machine.

TABLE II. — *Condition of the rotary cut and ploughed soils.*

Physical condition of the soil	Depth in cm:	Soil analysis: Rotary cut 26. IV	Rotary cut 18. VII	Rotary cut 7. X	Ploughed 26. IV	Ploughed 18. VII	Ploughed 7. X
Moisture content in weight percent.	—	12.8	11.4	20.3	13.3	11.9	14.9
	10	13.7	13.6	18.0	14.0	13.9	15.3
	25	15.1	13.8	13.1	15.1	13.9	13.0
Capacity for water in weight percent.	—	34.0	35.5	31.5	32.7	32.2	30.2
	10	35.5	34.1	27.5	33.9	32.9	31.3
	25	30.5	31.5	29.0	28.1	28.0	29.0

table I is the fact that for every 100 kg. of beets on cut soils we get only 51.5 kg. of tops and leaves when using Leuna nitrate and 56.2 kg. when using Chile nitrate, while on ploughed soils we get with Leuna nitrate 95.5 kg. and with Chile nitrate 84.1 kg. of tops and leaves; *i. e.* on the average we get from cut soils 53.8 kg. tops and leaves and from ploughed soils 89.8 kg. In other words, cutting shifts the relation between beet and leaves very much in favour of the former, a phenomenon characteristic of air nourishment in distinction to soil nourishment. From this the author feels justified in concluding that cutting with its intensive and uniform work of loosening the soil brings about a more rapid decomposition of the humus present in the soil and perhaps of the stable manure supplied, than does ploughing. Whether this is the correct explanation, or whether it may not be due to an impoverishment of the soil in carbon compounds on account of an increased assimilation, cannot be said with certainty at this stage; only further experiments can settle thispo int, and it is hoped to carry them out in the next few years. KASERER thinks that more CO_2 escapes from a cut soil than from a ploughed soil, and that the plant, being capable of satisfying its needs for carbonic acid by means of the comparatively small number of leaves it possesses, does not form any additional leaves.

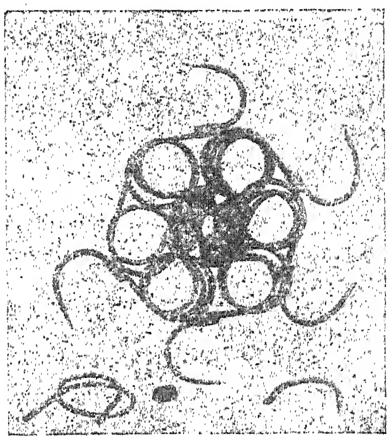


FIG. 62. — Part of Meyenburgian rotary cutting machine.

Another point noted by KASERER is that the cutting machine has also the advantage over the plough that it simultaneously performs a

number of tillage operations and hence makes unnecessary any further treatment of the field by the harrow, roller, etc. It is however advisable to study further this question and especially when applied to different soils; the above experiment is only an attempt at a study of the usefulness or otherwise of this implement.

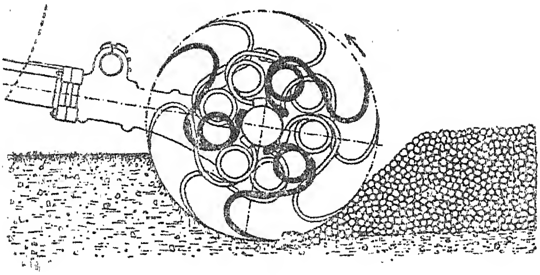


FIG. 63. — Diagramatic section through the working parts of a cutting machine.

The width of the work of the 30 H.P. machine is 160 cm. the depth according to setting, up to 35 cm. From ¼ to ⅓ hectare can be tilled in an hour, according to depth. The petrol consumption of the rotary tiller weighing 2700 kg. fluctuates between 24 and 32 kg. per hectare according to the depth of working.

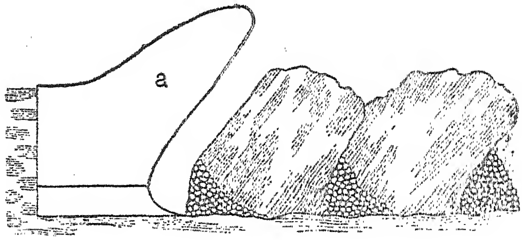


FIG. 64. — Diagramatic representation of ploughing. *a* = the plough.

The machine has three different forward speeds (45, 60 and 105 cm. per second), and one backwards speed of 45 cm. per second.

Besides this large machine smaller machines are constructed by the same firm with engines developing 4 or 8 H.P.

H. K.

194. **Flax-Scutching Machine.**

The Farmer's Journal, Vol. V, No. 12, pp. 1929, illustr. 5. Belfast, 1925.

The "Marshall" flax-scutching machine is semi-automatic in action. Experience has shown that completely automatic machines are not satisfactory, as every kind of straw receives the same treatment. It is not possible to guarantee uniform straw, and to allow for this, the "Marshall Scutcher", although not requiring particular skill to operate, permits of varying treatment of the straw, and ensures a uniform product.

The machine only requires one horse-power (B. HP.) to drive, and occupies a space of 4 ft. 3 in. by 2 ft. Ball bearings to shafts; lubricators accessible while machine is running.

The advantages claimed for the "Marshall" are: greater yield of flax from straw than by other methods; larger output per man; more uniformly scutched and better cleaned fibre.

W. S. G.

RURAL ECONOMICS.

195. Efficiency-Increasing Methods of Remuneration.

ATEDING Dr. Leistungssteigerung bei Transportarbeiten im landwirtschaftlichen Betriebe. *Deutsche Landwirtschaftliche Presse*, Year III, No. 21, p. 247. Berlin, 1925.

The transport of large masses of goods which takes place year by year between field, farm and station, should and could be cheapened and speeded up through the introduction not only of technical improvements, but also of agricultural economic improvements, as for instance through a proper organisation of work and a suitable method of remuneration. The possibilities in this direction the author illustrates by a number of practical examples taken from estates where efforts have been made to find the methods of organisation of work and of its remuneration best calculated to increase efficiency.

The author points out next that the manager has to determine in each separate case the true measure of efficiency. This may be the means of transport, the size of weight of the transported object, or even the area of land corresponding to the quantity of goods moved each referred to a unit of time. He then evaluates each separate phase, which together constitute the whole process of transportation, reckoning in each case time, space, money and effort. This analysis is the basis of a proper organisation of work and method of remuneration.

The transport work the author treats in the following manner: transport of sugar-beet, digging and loading of potatoes, bringing in of grain, conveying of stable manure and compost conveying. For the different phases of work, e. g. digging, loading, conveying, unloading, spreading, etc. different methods of remuneration were used. The methods of remuneration used were by time, by piece work, by group agreement, by premium, which was either simple or was rising by degrees. By economy of time, supervision and labour, splendid results were achieved, without in any way impairing the quality of the work or injuring the interests of the worker. The particulars are illustrated by a number of examples. V. E.

196. Changes in Estate Values in Germany.

ROTHKEGEL. Welche Veränderungen im Werte der landwirtschaftlichen Besitzungen sind in Deutschland eingetreten ?. *Illustrierte Landwirtschaftliche Zeitung*, Year XLV, No. 19, p. 227. Berlin, 1925.

The author attempts to establish the direction and the extent of the price variations which have taken place in the German estate market, and which are caused by the decrease of profits derived from agriculture, by the high interest on loans, by the high taxes and the general scarcity of available capital. Moreover, the farmer must share his decreased profits with the creditor and the State thus involving a general rise in the cost of production. The well known " vicious circle " results: rise in price of products is followed by a decrease in consumption, which causes an over-supply,

followed by a fall in prices to meet the buying power of the poorest consumer. In these circumstances the farms which suffer most are, in "the isolated State" of THÜNEN, those of worst economic conditions, and in present-day Germany, the farms on poor soils. On individual farms this finds expression in the fact that outlying fields of poor soils become unprofitable. Hence the profits and consequently the value of the land fell by different amounts for different soils and it is impossible to establish for all types of estate a general percentage decrease. Such a general percentage decrease, which will be true for all practical purposes of valuation, can be derived from the "valuation indices" to be found in pre-war official price lists. They each refer to one hectare of farm, including buildings, stock and land, and include farms of all sizes and of all the different qualities of soil. Assuming, as we are justified in doing, that the values of buildings and stock have changed only slightly and subtracting their value from the total values of the farm, we get the value of the land. Hence in the last resort fluctuations in the values of estates are really fluctuations in the values of land. When there is a fall in the total value of an estate, then the larger the proportion of that value which is represented by the value of the buildings and stock, the larger will be the percentage of decrease in the value of the land. And this proportion of the total value is clearly relatively large for estates with pour soils. In pre-war Germany such estates always showed, in contradiction to the ground rent theories of THÜNEN and RICARDO, a surplus above that required for the interest on loans and the expenditure on labour, *i. e.* when the value per hectare of such farms was 900 marks, and the price of the buildings and stocks was taken as 585 marks per hectare the value of the soil came to 315 marks per hectare. Nowadays, if such farms are cultivated at all, the profit from them is negligible. In the case of rye and lupins this profit may even become negative *i. e.* it does not suffice even for payment of the interest on loans. The fall in the income from farms with medium, good and best soils must have been equal to the income, before the war, from farms of the same size but on poor soils. The same is true of the value of land, and since we may assume that the costs of reconstruction of buildings and of replacing of stock are approximately the same as in pre-war times, the above statement is also true of the total value. From the total values of estates of all sizes and of small, medium, good and best land value, the author derives the net soil value (= capitalised ground-rent) of estates of the pocresr soil class, which are now unprofitable, and then compares those values with the pre-war values and gets as a result the tableon p. 437.

Despite certain possible and justified restrictions, the author believes in the usefulness of those figures, and next attempts to find out how far the prosperity and the readiness to buy of the German nation influences the estate market. Between the years 1896 and 1911, the wealth of Germany increased by 90 milliard marks by annually rising amounts. On the other hand its money wealth was to a large extent destroyed during the inflation period. That a considerable portion of that annually increasing wealth of the German nation was realised in agriculture is shown by the fact that parallel with this increase in wealth went a rise in the values and price of

Size in hectares	Farms paying land-tax on the basis of net return							
	1 Thal/ha		3 Thal/ha		7 Thal/ha		13 Thal/ha	
	had a value of Mark-hectare and decreased to . . . . % of their pre-war value							
	poor		medium		(good)		(better)	
	Mark-hect.	%	Mark-hect.	%	Mark-hect.	%	Mark-hect.	%
5.	1950	82	2320	85	2950	88	3420	90
10.	1530	78	1890	82	2520	87	2970	89
20.	1380	76	1710	81	2280	86	2710	88
50.	1136	72	1460	78	1990	84	2400	87
100.	1060	70	1380	77	1900	83	2280	86
500.	940	66	1230	74	1700	81	2090	85
1000.	900	65	1180	73	1640	81	2000	84

estates, which was very considerable indeed. Thus for example in Prusssia, in the case of farms of above 100 hectares, the rise in the period 1896-1914 was about 123 %. The height of this rise in values was reached after the introduction of the increased grain duties in 1905 with their effects on agricultural profits. The rise in prices as well as in the number of purchases was most marked for: 1. farms paying the lower rate of land tax on the basis of their net returns; 2. consequently, provinces with prevailing poor and medium soils (East Prussia); 3. among these, the larger sized farms. The rise in prices was especially marked in the case of this class of farms — farms with light-soils, which were previously in very small demand. This demand increased, from prospective buyers with available capital, as technical improvements, especially applicable to this class of farms, were introduced; and this increased demand allowed the prices to rise still higher. From these consideration also, the author concludes that, now that events have taken an opposite course, this class of farm will suffer the greatest decrease in value, which is in complete agreement with his first conclusions. V. E.

197. **Farm Costing in Ireland.**

ADAMS J. M. *Journal of Department of Lands and Agriculture*, Year 24, No. 4, pp. 351-373, tables 16, Dublin, 1925.

Great progress has been made in experimental work and research, but there is need for enquiry on economic questions relative to production, marketing and distribution of agricultural products. The basis of agricultural economics is cost of production and of distribution.

The production of farm commodities is subject to the law of diminishing returns. Within certain limits, cost may be reduced by increasing output or by improving the means of production; the normal productivity of land cannot be economically forced when prices are low. A stage is reached when the chemist and the engineer fail to be of service to the producer and the difficulty is economic.

It is of fundamental importance to the State to possess accurate economic data respecting cost of production and distribution of farm

commodities, capital invested, production per unit of area, capital and labour, sizes of farms in relation to production, system of farming and relative production.

Estimated costs are unsatisfactory and misleading; accurately recorded data are essential.

For the purpose of public evidence before an Agricultural Commission, the author compiled data from records and prepared tables of prices of farm requisites, wages, rates and items of farm expenditure for 1914, 1920 and 1922, and similar tables of prices of live stock and farm produce. The figures are based on the cost of producing crops on 18 farms.

No charge was made for interest on capital, or management.

The cost of production and value of crop per acre is compared in tabular form for the above three years. It appears that the value of the 1922 barley and potato crops was less than the cost of production, except in the case of very high yields. The author draws attention to the fact that barley meal is equivalent to Indian maize meal for pig feeding, and that pig feeders who do not grow barley would be well advised to buy barley meal in preference to maize, when it is at, or under the price of maize meal.

The cost of production of the milk from 204 cows on 13 farms is given for 1920, and the estimated costs for 1914 and 1922, including cost of delivery.

The average price realised in 1920 for milk was 1s.2d. per gallon, and the cost practically 11 d. per gallon; in 1922 price was nearly ½ d. per gallon less than cost of production.

Food and labour constitute over 80 % of the cost of keeping a cow; the importance of maintaining a good average yield from a herd is emphasised. There is no doubt that many cows in Ireland do not yield sufficient milk to pay for their keep.

The author demonstrates this by figures from a farm A, on which the cows were graded and milk records kept, and farm B, where poor quality cows formed the herd, and although the cost of keeping the cows was low, the cost per gallon of milk was very high.

	Cost of keep per cow 1920	Average yield of milk per cow	Cost of production per gallon
A	£25–16–8	727 gallons	8.5d.
B	£17–14–11	323 »	13.2d.

From the expenditure and receipts of the farms dealt with, index figures were ascertained for the given years:

	1914	1920	1922
Index of expenditure	100	230	192
Index of receipts	100	253	147

Thus the purchasing power of farm products, taking 1914 as a basis, increased about 10 % in 1920, but fell 23 % in 1922.

Financial results on costed farms indicate that in 1922 the farmer barely received remuneration for his own labour at current rates, and nothing in his capacity as capitalist and manager. With the fall in

wages in 1923 he received remuneration for his labour at a reduced rate, and 10 % of the output as return for his capital and management.

A scheme for investigation of farm finances was put into operation in 1924, but results will not be available until the end of the accounting year on these farms. W. S. G.

198. **Pre-War and Post-War Farm Costs of Wheat Production in the North American Spring Wheat Belt.**

Wheat Studies of the Food Research Institute, Stanford University, California, Vol. I, No. 1-6. and *Supplement*. Stanford, 1925.

The Wheat Studies of the Food Research Institute summarise an extensive analysis of available data on farm costs of producing wheat in the spring-wheat belt of the United States and Canada, under pre-war and post-war conditions.

The spring-wheat belt of North America includes the States of Minnesota, North Dakota, South Dakota and Montana, and the Canadian provinces of Manitoba, Saskatchewan and Alberta.

The procedure of the studies has been to construct, on the basis of the Canadian investigations for 1911 and 1923, and the United States investigations for 1909 and 1923, statistics of average yearly farm costs in each political sub-area of the spring-wheat region, for the periods 1908-14 and 1921-24. Numerous estimates and approximations had to be made, but material resulted which is more significant for intensive comparative study than any other published data. The importance was brought out of the influence of yields on costs per acre and the effect of summer fallowing on costs per acre.

Identical principles of valuation were employed throughout for items which enter into total costs per acre, excluding land charges. These items were materials costs, and costs of man and horse labour; materials were charged at cost. Labour charges were calculated on the basis of current rates for similar labour in the respective areas.

Farm costs of producing wheat may be expressed either per acre or per bushel, exclusive or inclusive of land charges. Costs per acre, excluding land charges, best reflect differences in technical conditions of wheat production. Costs per bushel including land charges are necessary in judging the relative ability of areas to produce cheaply.

The factors causing variations and increases in costs are: prices of labour, prices of materials, yield per acre, farm machinery and cultivation methods, summer fallowing, transportation facilities between farms and markets, and the practice of breaking new land. High yield affects costs per bushel in that it increases per acre costs of threshing and marketing by increasing the quantities per are. Summer fallowing increases per acre costs because it necessitates extra cultivation and involves double charges for land. To break new land increases expense owing to the greater labour required for ploughing and cultivation, and fallowed land must be cultivated although it lies idle. The crop of wheat grown on fallowed land must be charged with two years' rent. The practice of following extensively is much adopted in Canada, but not in the

United States. No one knows exactly how much higher Canadian yields must be above American, in order that Canadian costs may be lower than American costs. An additional yield of five bushels per acre will certainly suffice, but one bushel certainly will not.

A careful study of the data in these papers will show that summer fallowing is of such importance in its influence on costs that it serves largely to invalidate the current opinion that costs of wheat production are lower in the Canadian than in the American section of the springwheat belt.

The calculation of land charges and their inclusion as costs, showed diminished differences in costs per bushel. Costs per bushel, excluding land charges, ranged from 81.5 cents in Saskatchewan to 97.7 cents in North Dakota ; but costs per bushel including land charges ranged only from \$ 1.08 to \$ 1.20 in the same areas.

The general impression that Canadian spring-wheat growers are able to produce at materially lower costs per bushel than American farmers is not well founded. It appears that owing to the practice of summer fallowing, the yield per acre in Canada must be about three or four bushels in excess of American yield before costs per bushel are equalised in the two countries. For the period 1921-24, Canadian costs per bushel have been slightly lower than American.

To base a wheat tariff on differences between costs of production in Canada and the United States is neither scientific nor practical. It is not correct to assume that a normal or semi-permanent difference in production costs exists ; yet such an assumption lies behind the present duty of 42 cents.

Profits declined in all areas between the two periods, for costs rose faster than market prices.

Variations in profits per acre of wheat do not measure prosperity in the spring-wheat belt satisfactorily. Wheat was and is of unequal importance between any two areas, or between Canada and the United States, because other crops and live-stock were and are of unequal importance as sources of farm income. Conditions of tenure differ in different areas ; low profits or losses are more of a menace to prosperity in an area where tenants or mortgaged farms are more numerous. To employ State averages may misrepresent the facts not only of profits, but of yields, market prices and costs as well. This misrepresentation cannot be avoided, so long as published statistical material is compiled upon the basis of political geography, rather than upon that of economic geography.

Analysis of the best statistics obtainable on wheat in the spring-wheat belt throws little light upon fundamental economic problems. Cost statistics, particularly those applicable to crops whose yield is variable, are exceedingly unstable. The most significant aspect of cost statistics is that they sum up and reflect changes in the conditions of agricultural production. Their value in diagnosing agricultural prosperity, or in providing a sound basis for price-regulating legislation, direct or indirect, is slight.

In the case of the United States maintenance of an export surplus

of wheat cannot properly be urged on the ground of insurance against famine or even serious food shortage. Such danger is negligible even with a world shortage, considering food resources of the country, possibilities of substitution, transport facilities, and the strong economic position of the country. In short, any export surplus of wheat is by no means indispensable to the United States,

No tariff policy has yet been formulated that will protect agricultural or industrial enterprises from the readjustments necessary after a period of over-expansion, or from losses incidental to such readjustments.

W. S. G.

199. **The Returns fron Sugar-Beet Growing in Germany and Czechoslovakia.**

I. GARCKE. Die Kosten des Anbaues der Zuckerrüben. *Illustrierte Landwirtschaftliche Zeitung*, Year XLV, No. 23, p. 275. Berlin, 1925.

II. UMLAUF. Kultur und Rentabilität der Zuckerrübe. *Landwirtschaftliche Fachpresse für die Tschechoslowakei*, Year III, No. 13, pp. 113-114. Tetschen, 1925.

I. The author attempts to determine the present limits of profits from sugarbeet cultivation in Germany. He starts from the following data: wages per man per day 3.50 marks, horse per workday 4.00 mks., one quintal stable manure 0.80 marks, one quintal beets 4.00 mark, one quintal beet tops for sour fodder 2.00 marks, one quintal dried slices 10.00 marks; — crop per hectare 3000 quintals of beets, 240 quintals of clean beet (20 % loss), 150 quintals beet tops and leaves and 105 quintals of ensilage (30 % loss).

The calculation of the expenditure per hectare is as follows:

(1) Autumn cultivations: Cleaning land 13.20 mk., 300 quintals stable manure utilised 60 % 144.00 mk., loading 18.60, cartage 59.00 mk., spreading 4.80 mk., deep ploughing 72.00 mk.	321.60 mk.
(2) Spring work: Cleaning, spreading artificial fertilisers, digging, harrowing, rolling, sowing, further rolling and harrowing, 60.00 mk.; 2 qs. ammonium sulphate during tilling and 2 qs. sodium nitrate as a top dressing, 96.00 mk., 4 qs. superphosphate, 34.00 mk., 2 qs. 40 % potash 15.00 mk.	205.00 mk.
Total . . .	526.60 mk.
(3) Cultivation work: Three hand and two machine hoes, working separately and together	188.00 mk.
(4) Harvesting: Digging 72.00, loading and unloading 8 pfennings per quintal, 24.00 mk., cartage of beets and leaves 92.00 mks.	188.80 mk.
(5) General costs: Rent 120.00 mk. per hectare, Interest on capital 80.00 mk., taxes and rates 48.00 mk., general costs 12.00 mk.	260.00 mk.
Total expenditure per hectare . . .	1083.40 mk.

Returns :

240 quintals clean beets at 4 mk.	960.00 mk.
105 quintals ensilage at 2 mk.	210.00 mk.
12 quintals 5 % dried slices at 10 mk.	120.00 mk.
Total return per hectare . . .	1290.00 mk.

There is thus a net gain of 206.60 mk. per hectare. If the price obtained for beets falls, however, to 3 marks per quintal for the same crop,

TABLE II. — *Profits of sugar-beet compared with other crops at Sokol.*

I	II	III	IV	V	VI	VII
Cultivated Plant	Yield in quintals	Value per q.	Value of the yield	Cost of cultivation	Removed for food	Gross profit
Sugar-beet. .	270 quintals of beet 175 » leaves. 148 *) quintals free slices . . . . . 27 kg. free seed. . free sugar	18 4 5 **)12	4860 700 740 324 90	1. — 3. Cultivation of the different harvests	N, P_2O_5, K, Ca in money value	Column (IV) — (V + VI)
			6714	1200	1093	4421
Wheat .	31 q. grain . . . 50 q. straw . . .	240 20	7200 1000			
			8200	450	1010	6740
Oats . .	25 q. grain . . . 50 q. straw . . .	220 25	6250	450	704	5096
Potatoes	180 q.	40	7200	1100	782	5318
Flax . .	35 q. straw . . . 5.5 q. seed . . . 4 q. bolls. . .	160 350 30	7845	700	540	6605
Caraway	12 q. seed. . . . 20 q. straw . . .	800 20	10000	650	?	> than with 270 of beet per hect.
Poppy .	10 q. seed . . .	750	7500	900	?	> do.
Rape . .	18 q. seed . . . 35 q. straw . . .	350 20	7000	700	926	5374
Hemp .	40 q. stems . . . 8 q. seed . . .	120 400	8000	?	?	> than with 270 of beet per hect.

(*) 55 %.
(**) per kg.

instead of a gain there is a loss of 33.40 mk. and the limit of profitability is for a minimum yield of 320 quintals clean beets per hectare. This yield can be obtained with the given manuring and favourable weather conditions. When, however, the price falls below 3 marks per quintal for beets, the crop becomes unprofitable.

In Czechoslovakia sugar-beet cultivation is only profitable in those parts of the country where with heavy manuring and very careful attention to all field cultivation (subsoiling etc.), rolling, hoeing and harvesting, the yield should be 350-500 quintals per hectare. If yields are smaller, most other cultivated crops would give better profits. Where such yields are not obtained and where unprofitable sugar-beet cultivation is carried out only on account of rotation of crops, the author advises a change to other industrial crops. This is also recommended from an agricultural political point of view. Since $^2/_3$ of the sugar must be exported, the sugar trusts depress the price of the sugar so much that, even with, a yield of 270 quintals per hectare, the beet cultivator already shows a loss. The author suggests a close combination of all sugar-beet cultivators, and shows in the preceding table the profit of sugar-beet cultivation, as compared with the most important crops and especially with the recommended commercial plants (see page 442). V. E.

AGRICULTURAL INDUSTRIES.

Plant Products.

200. The Classification of Cereals in Roumania.

IONESCU SISESTI, G. Standardizarea di Clasificarea cerealelor. *Viata Agricola*, Year XVI, No. 2, pp. 33-37. Bucharest, 15 January 1925.

The author examines the proposal of the Roumanian Government regarding the introduction of an enactment defining types of cereals and making a classification of crops. The author emphasises the importance of this measure and points out the drawbacks of the present condition of affairs, illustrating the difficulties arising from the subdivision of agricultural production due to agrarian reform, the consequent variety of the products and absence of any uniform stocks, of installation for grading or storage, of means of transport, etc., and consequently, the impossibility of obtaining credit on the crop and of arranging for sale at the right time.

These difficulties could be removed by the provision of warehouses, the defining of types and compulsory grading, which would also influence cultivation, since the price being based on quality, the farmer would tend towards the production of superior crops.

The author reviews what has already been done by the Roumanian

Government in this field since 1897 and gives fundamental suggestions for the regulations for the grading and storage of cereals including:

(1) Clear definition of the objects proposed by the system of defining types and compulsory grading, first in the ports of exportation and then in the interior, according, as the present defective warehousing system is completed.

(2) Constitution of an Association representing all interests — producers, dealers, banks and co-operative societies — with national capital for the construction and working of the warehouses. This Association should be a private corporation with partnership of the State, in conformity with commercial law.

(3) The grading should be effected by competent agents of the State appointed for the purpose, and special bodies and associations; Chambers of Agriculture, Agricultural Syndicats, etc. should cooperate in the definition of types and in the creation of the organisation for classification and grading.

Transactions should only be done on the basis of certificates issued by the warehouse management, indicating the class to which the produce belongs and the quantity released.

The said certificate would form the "warrant" or storage receipt and could be discounted at the National Bank or other banking institutions, to facilitate credit, and the law should recognise its character as a negotiable document.

This enactment does not constitute a monopoly of cereals, since trade remains perfectly free, but it facilitates trade by making known the grades of ing known the grades of Roumanian cereals intended for exportation, grades which will be guaranteed by the State and which will benefit by this measure; moreover, the confidence of the Exchange will be increased and as an immediate consequence, the present fluctuating prices will be stabilised at a higher level. W. L.

201. The Treatment of Flour with Chlorine Gas and by the "Golo" Process.

NEUMANN M. P. and KALMING H. (Institut f. Bäckerei der Preussischen Versuchs- und Forschungsanstalt f. Getreideverarbeitung und Futterveredlung). Die Behandlung der Getreidemehle mit Chlorgas und das sogenannte Golo-Verfahren zur Verbesserung der Mehle. *Landwirtschaftliche Jahrbücher*, Vol. LXI, No. E, pp. 305-319. Berlin, 1925.

Among the measures suggested in recent years for the improvement of flour is that of treatment with chlorine gas, introduced about thirty years ago. The bleaching which results is due to the oxidation of the yellow colouring matter which is found in the fats of the flour. This method however, is not common because it has certain drawbacks. It has now been replaced by the "Golo" process in which 0.5-1.5 % of nitrosyl chloride is added to the Chlorine gas. The gaseous mixture to which is added a certain amount of air is passed into a receiver containing the flour which is constantly shaken and thus in a short time comes into close contact with

the gas. The flour rapidly absorbs the gas; in concentrations of 0.015-0.02 which are considered normal, the flour retains no odour, nor can any traces of hydrochloric acid or of nitrous acid be found. Under the influence of the gas, the swelling capacity of the colloidal substance of the flour, especially of the albumen, increases. A greater capacity for water results and therefore a greater quantity of dough, which is more tenacious, softer and more susceptible of increase in volume during the process of bread-making.

This action is due to increased acidity in the flour, both of measurable acid and of hydrogen-ion concentration. With it also increases the solubility of the nitrogenous substances; if however these two factors increase beyond a certain point, as happens especially with soft wheats, the gas may have no effect or it may even have a negative effect, as is the case when the action is too prolonged. The gas has no effect either on the keeping qualities of the flour or on the activity of the enzymes of the flour. Complete bleaching of the flour will result, if the treatment is properly carried out, and the yellowish colour will disappear; if on the other hand the quantity of gas is excessive the flour may take a greyish tone.

The action of the gas depends mainly on the accurate carrying out of the treatment, which may be considered as harmless on account of the very small quantity of gas used and the cleanly manner in which the process must be performed. A. F.

202, **Preservation of Silage.**

KOCH L., Conserveeren van veevoeder door inkuilen. — *Algemeem Landbouwweckblad voor Nederlandsch Indie*, p. 1. Baandoeng, 1924.

After the forage has been in the silo for four to five months, the loss is 10 %. The carbo-hydrates undergo a great diminution: on the other hand the fat content is greater, probably because the bacteria transform the carbohydrates into fats. The results are similar to those obtained in America.

A. F.

203. **Industrialisation and Commercialisation of Fruit Growing in Roumania.**

STEFANESCU D. L. "Industrializarea si comercializarea fructelor" *Buletin Agriculturei*, Year 5, II. Series, Vol. IV, No. 10-12 October-December, Bucharest, 1924.

The author points out how, in spite of the good climatic conditions throughout the country, fruit-growing, on account of unscientific methods, leaves much to be desired.

There are in Roumania about 100 million fruit-bearing trees of which about three-fourths are plum trees, but the distribution in the districts of the species is very unequal. Thus in the old Kingdom, out of 47 million fruit-bearing trees, 42 millions are plum-trees.

The mountainous districts (Muscol, Prahova, Argos and Dambovita) have each about 6 million plum-trees, while the Dobruja and Southern Bessarabia have scarcely any.

The plum-tree represents 90 % of the fruit trees of the Old Kingdom, 65 % in Transylvania, 32 % in Bucovina and 6.1 % in Bessarabia

Fruit-growing suffers principally from the climatic conditions, from fungoid diseases, parasites, etc., to which are added the damage caused by complete want of care and of scientific methods of picking, transport and storage of the fruit.

A quite insufficient use of orchard products is madei n Roumania and the complete absence of industrial and trade organisation is a source of great loss. The value of the annual fruit production of Roumania exceeds 2 thousand million *Lei*.

The author mentions the various uses of such potential wealth :— the manufacturing of jam and dried fruit from the plums, introduction of various fruit wines, sparkling table wines, preparation of syrups and drying of fruits and vegetables.

The export of these fruits in the above-mentioned forms would assure an income of hundreds of millions of *Lei* to the country.

As regards utilisation of the products of Roumanian orchards, in the majority of cases, especially in the Old Kingdom, the plums are made into "tuica" by a process of distillation. This is a not very wholesome beverage widely used by all social classes of the country as an aperient and common beverage, but not exported as it is not liked in foreign countries.

64 million plum trees yield a gross output of 64 thousand trucks of fresh plums, or the equivalent of 18-20 thousand trucks of dried or preserved plums; if one quarter only be used for industrial purposes other than the manufature of "tuica", there would be about 4-5 thousand trucks of dried plums or jam for consumption or exportation. Considering only the production of 9 Departments, with approximately a total of 41,107,269 plum-trees, and allotting only one quarter of their output for industrial purposes, 3-4 thousand trucks of dried plums and jam could be obtained having a value of 400 million *Lei* (at 10 *Lei* per kg. of dried plums). Half the quantity might be made into dried plums and the other half into jam. The work would occupy about 4 thousand Bosnian ovens for a month, and perhaps an equal number of boilers for the jam.

The author alludes to the exportation of fruit from Roumania to Austria and Germany in the years 1913-1914-1915, which reached an average of 285 trucks a year.

For Bessarabia alone, taking the average of the ten years 1901-1910, 2000 trucks of fruit were exported. As in 1915 the production of Bessarabia was 8723 trucks of fruit, one-quarter of the output of fruit from this Province might have been exported.

The markets for dried plums of superior quality would be :— Russia in the east ; Germany, Austria, Belgium and England in the west. The industrialisation of fruit-growing has for some years occupied the attention of the Ministry of Industry and Commerce and that of Agriculture and Domains in Roumania. In about 4 years (1909-1912) with Government assistance, 500 ovens of the Bosnian system were constructed ; 2000 ovens were made during the occupation. Various tanks were made since 1910 at Pucioasa (Dambovitza) and Rusavat (Buzen) as well as two large

factories, one at Golesti-Badi (Muscel) and the other at Istritza (Buzen), each with a capacity for sterilising about 2000 kg. of dried plums in 24 hours. The preserved fruit industry is meanwhile in full progress in the country, gradually eliminating similar foreign products from the market.

In order to be in a position to organise the production and sale of fruit with the object of its commercialisation the author proposes :—

(1) Detailed research on the soil and climate, of the cultivation of each species and variety of fruit, as well as their correct cultivation, picking at a suitable moment, suitable packing methods, establishing for this purpose schools, exhibitions, competitions, conferences and publications.

(2) Gradual change of the present destination of fruit products, especially plums, with industrialisation, adopting the improved Bosnian oven, an oven capable of dealing with about 5000 kg. in a season.

(3) Careful preparation of the goods, superintendence and control of markets, establishment of contacts by means of Chambers of Comtion of local consumption by supplying hospitals, prisons, etc.

(4) State cooperative aid for the construction of ovens, creating for the present two centres of production — Golesti and Istritza — where the two factories might prepare (by sterilisation) 70 trucks of plums for exportation.

(5) Construction of nursery plantations, propaganda work with specialised schools of fruit-growing, conferences and shows.

(6) Lastly, formation of a competent directing staff under a Special Directorate of Fruit-growing to be created in the Ministry of Agriculture.

S. L.

204. **Drying of Apricots.**

GRASOWSKY A. *Commercial Bulletin*, Vol. 1, No. 8, pp. 196-198. Jerusalem, 1925.

The author gives the chemical composition and nutritive value of dried apricots, and the advantages to be gained by drying the fruit.

The method of drying apricots, is described as follows :— The fruit is picked when ripe, as green fruit produces a tasteless product, and is then cut in halves, spread on trays and taken to the sulphuring house.

The fruit is sulphured for the following reasons : Sulphurous acid deoxidises colouring matter and prevents darkening and the decomposition of nitrogenous compounds. Spores are destroyed, which checks putrification and fermentation, also, the eggs of insects are destroyed, and the fruit is made secure from insect attack.

Sulphuring also ruptures and enlarges the cells of the fruit, makes the texture more porous and hastens drying. The length of time required for sulphuring varies with the fruit, the draught and the quality of sulphur. The time taken is usually about 2 hours, and about 5 lb. of sulphur per ton of fruit is employed.

After sulphuring the fruit is dried in the sun; the time required depends on various factors, but generally after 4 days the apricots are

three-fourths dry, when the trays are stacked and the drying is finished in the shade.

When dry the fruit is put in bins and sweated, which equalises the moisture, makes the apricots less brittle and the product more palatable.

After sweating, the fruit is sent to the packing house where it is usually re-sulphured, graded and packed in wooden boxes for market.

Mention is made of the limiting factors to apricot growing in Palestine, e. g., cold winds and rain at time of blossoming and the Fruit Fly (*Ceratitis capitata*), which all cause serious damage, and the prevalence of Gummosis. W. S. G.

205. The Fungicidal Action of Sodium Fluosilicate and Hydrofluosilicic Acid in the Coagulation of Rubber.

LAMBERT A. *Archives des Instituts Pasteur d'Indochine*, No. 1, pp. 57-64. Saigon, 1925.

Hydrofluosilicic acid and fluosilicate of soda have been recommended as coagulants in a patent taken by the Rubber Growers' Association in the name of Mr. EDWARDS.

The advantage claimed lies in the fungicidal action of the new coagulant which would prevent the formation of mildews on the surface of the rubber during the process of drying which depreciate the market value of the rubber.

The writer purposed to investigate the fungicidal action of these coagulants, the yield of washed rubber, the chemical composition and the mechanical properties of the rubber obtained.

The mildews which grow on rubber are of the *Aspergillus* and *Penicillium* type.

The optima conditions for mildew development are a slight acidity in the medium, a temperature near 32°-34°C. and a suitable hygrometric condition. In dry air growth is slower than in moist air.

It should be noted that rubber, always slightly acid after coagulation in an acetic medium, kept in a surrounding temperature of about 30°C. in an insufficiently ventilated drying shed where the hygrometric condition is marked, is in a condition favourable to the development of spores by which it may be infected.

From the investigation made by the author the following conclusions may be drawn :—

(1) In the conditions of the experiment, the fungicidal action of hydrofluosilicic acid and of fluosilicate of soda has not been sufficient to prevent completely the growth of mildews. However, development and fructification have been very much retarded. It is therefore possible that in a drying shed where the moisture conditions are less favourable this delay may allow of drying the rubber to the point that the development of mildews would no longer be possible.

(2) The fungicidal action of fluosilicate of soda proved superior to that of fluosilicic acid.

(3) Coagulation by fluosilicate of soda in suspension in water is better than that obtained by the salt in powder. In the latter case the latex should be poured on the powder and not the powder into the latex.

(4) The chemical composition of the two samples of rubber is much the same. It is scarcely possible to find any difference except a slight increase of ash and a decrease of resins in the sample coagulated with the fluosilicate.

(5) Coagulation with fluosilicate of soda is deficient, compared with that with acetic acid.

(6) The characteristic coefficients of each rubber, with optimum vulcanisation, are respectively 1.05 for the sample coagulated with acetic acid and 0.91 for the sample coagulated with fluosilicate of soda. The latter is only worth 86.8 % of the sample coagulated with acetic acid.

(7) The characteristic coefficients after keeping are respectively, 0.66 for the sample coagulated with acetic acid and 0.45 for the sample coagulated with the fluosilicate. After keeping, the latter is not worth more than 67.6 % of the sample coagulated with acetic acid.

P. C.

(*Correspondent for Indo-China*).

Animal Products.

206. The Constitution of the Fatty Globules of Milk.

DEGLI ATTI M. (R. Scuola sup. di Agricoltura di Portici). Ricerche fisico-chimiche sulla costituzione dell'involucro dei globuli grassi del latte. *Annali della R. Scuola superiore di Agricoltura in Portici*, Ser. II, Vol. XIX, pp. 1-23, bibl. Portici, 1924.

The various hypotheses regarding the constitution of the fatty globules of milk appear to have little correspondence with the real facts, especially as they do not explain the observed phenomena, or are even in contradiction with them. The author puts forward a new hypothesis based on the formation round the globules of a thin layer of calcium soaps (soaps of the various acids contained in butter and especially insoluble soaps of the higher series of fatty acids).

This mixture of soaps, besides remaining attached to the globules themselves, has the property of fixing the suspended and colloidal particles contained in the milk (insoluble phosphates, casein), forming a complex viscous, heavy compound which envelops the fatty globules and keeps them in an almost stable emulsion.

By means of this hypothesis are explained :—

(1) The considerable density of the globules covered with calcium soap and the difficulty in rising of cream.

(2) The fact that, with any chemical and physical treatment capable of displacing the calcium and, consequently of decomposing the calcium soap, the rising of the cream and all the phenomena which are observed in making butter take place at once. On the other hand, treatment with

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agents incapable of causing the decomposition of the calcium soap retards and renders incomplete the formation of butter.

(3) The fact that the formation of butter is easier with acidified cream (lactic acid which decomposes the calcium soap) and more difficult with sweet separated cream, precisely on account of the resistance which the soapy covering offers to the formation of butter. A. F.

207. A New Method of Distinguishing Fresh from Boiled Milk.

HECKMA E. (Rijkslandbouwproefstation Hoorn). Een nieuwe methode ter onderscheiding van rauwe en verhitte melk. *Verslagenv an Landbouwkundige onderzoekingen der Rijkslandbouwproefstation*, No. XXIX, pp. 49-60. The Hague, 1924.

To 5 cc. of milk, previously filtered through cotton, is added 5 cc. of a 0.1-0.2 % solution of "trypanblue" in distilled water, or better, in physiological solution. The mixture is placed in a tube of the separator, the lower part of the tube being capillary (for example, Trommsdorff's tube). It is left at room temperature for 10 minutes and then rotated for 20 minutes. The cream and the skim milk are poured off and the small amount of liquid remaining above the sediment is withdrawn by means of a capillary pipette. The sediment is then thoroughly mixed with a capillary pipette. One or two drops of the sediment are taken (always the same quantity) and examined under the microscope, taking care to spread the matter evenly between the object-glass and the cover-glass. The sediment is examined with a dry lens, and the number of stained and unstained cells, the intensity of the staining and the number of cells forming the average for 25 squares should be noted.

Care should be taken not to mistake the cells for small drops of fat or scum membrane.

The following results are obtainable :—

(1) Fresh milk. Only unstained cells (relatively large) are seen.

(2) Strongly heated milk (10′ at 70° C.; 2′ to 3′ at 80°-90° C.; 1′ to 2′ at 100° C.). A great number of deeply stained cells are seen, while unstained and slightly stained cells are absent.

(3) Milk heated to a low temperature (10′ to 30′ at 60°). A fair number of slightly stained cells

(4) Mixture of fresh and strongly heated milk. Side by side with deeply stained cells other unstained cells are seen.

This method also holds good if formalin or bichromate of potassium has been added to the milk, in which cases STORCH'S and ROTHENFUSSER'S reactions (enzyme tests) give no indications. A. F.

208. Cold Storage of Eggs.

MORANT T. and PIQUE J. *Cold Storage and Produce Review*, Year 28, Vol. XXVIII, No. 32, pp. 9-11, 2 fig. London, 1925.

Results of researches on the cold storage of eggs, made at the Low Temperature Research Station, Cambridge, for the Food Investigation Board of the Department of Scientific and Industrial Research.

(1) Only very fresh, clean eggs, which have not been subjected to a temperature of more than 15.5°C (60°F.) should be used for cold storage, since at 21°C. (70°F.) a visible development takes place in the egg; even at 16.1°C. (61°F.) embryonic modifications are produced.

(2) The storage temperature should in practice be maintained between 0° C. and + 0.5° C. (32° to 33° F.).

(3) To avoid as far as possible loss of weight, the degree of humidity should be kept constant at 80 % and the temperature at 0° C.

(4) To avoid "storage taste" the eggs should be placed on metal plates, or plates rendered impermeable and not susceptible of absorbing odours. P. D.

PLANT DISEASES AND PESTS.

Non-parasitic Diseases.

209. **Manganese Treatment for the "Dörrflecken" Disease of Oats (Moor Colonial Disease).**

HILTNER F. Die Dörrfleckenkrankheit des Hafers und ihre Heilung durch Mangan. Das Kohlensäure-Mineralstoff-Gesetz, ein Beitrag zur Physiologie dar nichtparasitären Pflanzenkrankheiten. *Landwirtschaftliche Jahrbücher*, Vol. LX, part 6, pp. 689-769. Berlin, 1924.

The "Dörrflecken" disease is known as a non-parasitic disease of oats and under certain circumstances also of other plants. It is found especially among plants growing on sandy soils and on moors, and has the following course: after the seed has germinated in the normal manner the plants change colour slightly, then on the leaves appear red-bordered spots from which the chlorophyll disappears; finally the leaves gradually dry up from the base of the stalk to the tip. Sometimes the disease stops after a time, but oftener the plant perishes. Many attempts at explaining its cause can be found in the literature, among the causes suggested being both acidity and alkalinity, nitrite forming bacteria, lime and many others. Nobody, however, suspected the physiological processes occurring in the plant.

In manganese sulphate HUDIG found a very efficient weapon for controlling the disease, but no final and satisfactory explanation for its action was so far given.

The author tried to investigate the relation between the factors conditioning the disease and the curative action of the manganese and to explain satisfactorily the cause of the disease. For this purpose he investigated a large number of oat cultures in water and in the open field, and the following are the results obtained.

Experiments in water. The " Dörrflecken " disease is not connected with the soil, for it may even occur in purely mineral solutions. The severity of the attack is largely influenced by the form of the nitrogen given to the plant. Yellow oats and " *Fichtelgebirge* " oats respond quite differently to the disease. MnO_2 has the same preventive influence as $MnSO_4$, but only in the series of experiments with KNO_2 were negative results obtained. The disease is not confined to alkaline reacting bodies, for it may be even found in decidedly acid solutions (solutions of $(NH_4)_2SO_4$) and is then also curable by $MnSO_4$. The presence of a nitrite in the solution may lead to the disease — and hence i.s appearance on moor soils with a lime fertiliser — but this is not the only condition favouring the appearance of the disease. The disease appears even in the complete absence of calcium bicarbonate, and hence the explanation of the beneficial action of the manganese as being due to its action on the former or on the alkaline humus matter is certainly insufficient. Similar to manganese sulphate is the action of many other manganese compounds *e.g.* manganese chloride, manganese dioxide, manganese carbonate and even manganese mud. Finally these experiments in water proved that opt'mum limit in the case of oats is not yet reached, even with 0.5 gm. $MnSO_4$ in 600 cc. of water.

The pot experiments proved that the action of the manganese was more beneficial the stronger the hold the disease had previously on the soil investigated. Its action was greatest on alkaline garden soils which were manured with KNO_3 and the result was a surplus yield of 91 %. We are justified in stating that all plants which growing on calcareous soil suffer from nutritive disturbances are manganese-requiring plants, and one of the experiment showed that every 5 gm. of MnO_2, in the first year, had a more beneficial influence on the crop yield than 2 ½ gm. $MnSO_4$ on 6 kg. of soil with an especially high Ca and Mg carbonate content. The beneficial action of the $MnSO_4$ was also noticeable in following years to the same extent. The same beneficial action was also noticed in the case of another plant disease, which may be ascribed to nutritive disturbances, and in which the lower leaves withered gradually from the tip towards the base. On application of a manganese treatment new leaves appeared. It was further found that manganese cannot be substituted by other reagents which perhaps assist oxidation in the soil. The disease appeared less frequently in soils with a purely organic manure than in soils having a purely acid manure, and hence the action of the manganese in the first case was weaker. The effect of various nitrogenous manures, which was investigated in the former series of experiments was again examined and it was found that sodium nitrate, crude calcium cyanamide were injurious and somewhat less the physiologically acid ammonium sulphate, while the neutral $(NH_4)_2SO_4$. $NaNO_3$ acted as a preventive. The most injurious, however was KNO_3, whose nitrogen is only assimilated in the presence of manganese which itself prevents the appearance of the disease. The same was noticed in the series without nitrogen, with the limitation, however, that in these cases the sulphate acted much better than the chloride. In the case

of KNO_3 manure the beneficial action of the manganese found expression in a much greater grain yield. It may be inferred from this that the action of the manganese is catalytic in that it assists in either the nitrate reduction or nitrite oxidation or may be in the albuminoid syntheses, by supplying rapidly the necessary bodies, whose absence may cause the above mentioned nitrogen transformations to stop at injurious intermediate stages. It is probable that these inert and lacking substances are carbohydrates on whose diastatic changes manganese exerts a beneficial influence. With nitrogenous manures another two different observations were made: (1) that the crops receiving crude calcium cyanamide in the absence of manganese were very poor, while in the presence of manganese they exceeded those obtained even with $(NH_4)_2 SO_4$. $NaNO_3$ manganese, and (2) that the poisonous action of guanadine nitrate was completely stopped by manganese. Also calcium, magnesium and potassium salts as well as phosphatic manures were investigated. In distinction to the experiments in water cultures it was found that on alkaline garden-soil KCl acted as a preventive, while potassium silicate, mono- di- and tricalcium phosphates increased the liability of the plant to the disease, but this is to be expected, since they increased the physiological alkalinity of the garden soil. Magnesium sulphate reacted favorably in distinction to the carbonate, $CaCl_2$ acted as a preventive, $CaHPO_4$ diminished the danger of "Dörrflecken" formation. Interesting was the observation that a 14 cm. thick layer of lime under 13 cm. of garden soil prevented the appearance of the disease, another proof that neither lime itself, nor an alkaline reaction by itself, can be considered as sufficient cause for the appearance of the disease. From among the phosphatic manures Rhenania-phosphate was the most poisonous, although even in the presence of superphosphate, crude phosphate or basic slag the disease appeared and usually in two phases. The manganese acted beneficially in each case, most in the case of Rhenania phosphate, least in the case of superphosphate.

The open field experiments were primarily qualitative experiments, and they proved that the degradation processes and the greater liability to the "Dörrflecken" disease, which is noticed in the case of mountain varieties of oats when grown in other suitable places, is transferred also to the seed. The action of the manganese depended to a large extent on the different environmental influences extended on the plant. The liability to the disease is also conditioned by all the influences exerted on the development of the seed.

The question whether the action of the manganese is due to its influencing the processes taking place inside the plant or in the soil, was answered by the following experiment. A plant grown in a nutrient solution containing manganese sulphate was transferred to a soil from which manganese was completely absent and yet showed no signs of acquiring the disease. This shows unmistakably that the manganese has some influence on the processes taking place inside the plant. In the above experiment the manganese must have reached the leaves of the plant in

the early stages and remained there. The same beneficial results were achieved on painting the " Dörrflecken " leaves with manganese sulphate solution, especially if $FeSO_4$ was supplied at the same time.

In the diseased leaves the internal processes were found to have a considerable increase in the peroxydase content, while in the case of healthy leaves a preponderating amount of catalase was found. In the latter a peroxydase fever could be artificially produced by manganese. In view of this it is reasonable to assume that in the case of formation of injurious substances these are immediately oxidised. These injurious substances are formed readiest in the so-called " second youth stage " of oats, between the stages of " stemming " and " shooting forth ", and in this stage the formation of the very strong secondary roots takes place. Because of this the plant has soon available about ten times the mass of roots of either wheat or rye, and is capable therefore of withdrawing from the soil nearly double the amount of nitrogen as is withdrawn for example by barley, and in this way it can store up, already in the first four weeks, 10 % of its dry weight and about 25 % of its final ash weight. If this is so, the equilibrium between root and leaf nourishment is easily disturbed, which is followed by the formation of injurious substances in the leaves. The deficiency of nutrient salts in young plants, accelerates flowering and prevents the appearance of the disease. The same thing might be observed in young plants if they were supplied with carbonic acid which could absolutely replace manganese in its action. Hence the fact, actually observed, that all climatic influences which increase assimilation (light, CO_2) cause a diminution in the liability to the disease and the action of manganese and vice versa, and also that increased transpiration, with an accompanying increased supply of soil nourishment, if not followed by increased CO_2-assimilation leads to a readier appearance of the disease and increased action of manganese. Salts reacting on the leaves which, on account of a shortage of carbohydrates, cannot be used up, begin to act as obstructing substances in the generative stage of oats, and lead to the appearance of the disease, while all causes which accelerate the flowering and among them a carbohydrate excess, lead to the disappearance of the disease.

The beneficent action of the manganese the author explains by assuming that its presence causes an increased CO_2-assimilation. His conclusion he embodies in the following "carbonic acid mineral matter law": " If the plant is to attain the best health and if no disturbance is to take place in the equilibrium of the chemical compounds necessary for its formation, an increased supply of soil-nourishment has to be accompanied by an increased CO_2-assimilation. If conditions of weather, light and especially heavier artificial manuring do not permit the bringing about of these optimum conditions, then disease sets in, which under certain circumstances is transferred to the seed ". In the case of such nutritive disturbances a manganese fertiliser acts very beneficially, heating, stimulating growth and enabling the plant to make the fullest use of the soil nourishment.

E. V.

Plant Parasites.

210. **The " Peronospora of the Hop " (*Pseudoperonospora Humuli*) reported in Wurtemberg, Saxony, Bohemia and Alsace** (1).

LANG W. Der falsche Mehltau am Hopfen. *Nachrichtenblatt für den deutschen Pflanzenschutzdienst,* Year 5th, No. 8, pp. 63-64. Berlin, 1925.

In Wurtemberg, and particularly for the first time during July 1924 in the district of Tettnang, and in the middle of June 1925 here as also in the great hop district, which extends from Horb to Herrenberg, was reported the rapid spreading of the " peronospora of the hop " (*Pseudoperonospora Humuli* (Myabe and Takah.) Wils.

Also in 1925, equally intense attacks of the disease were recorded in Bavaria, Bohemia and Alsace.

Against this disease, which may constitute a serious danger to hop growing, treatment with copper solutions is recommended, carried out at suitable periods. G. T.

211. ***Alternaria Fici*, Hyphomycete injurious to the Fig, in Piedmont.**

GHIRLANDA C. Sopra una malattia del Fico. *Annali della R. Accademia d'Agricoltura di Torino,* Vol. LXVII (1924), pp. 71-76, 2 fig. Turin, 1925.

At Turin at the end of August 1923, the author observed for the first time an abundant fall of young receptacles (syconiae) from a fig tree (referable to var. " Troiano " also called the " Livia " fig), which otherwise appeared to be quite healthy. The small fallen receptacles, which were deformed by irregular growth, showed, on one side only, a large rounded spot, depressed, edged with a pad of darker colour than the surrounding zones. In the syconiae in which the disease had made most progress the spot was to a great extent covered with a slender velvety down of a rather dark olive-brown colour. Microscopic examination of such down revealed the presence of a Hyphomycete, classified by the author as *Alternaria Fici*, already described by R. FARNETI as carrier of the " atrophy of the fruit of the fig-tree ", a disease found by him for the first time in the Province of Pavia.

Contrary to the observations of FARNETI, the author found that the mycelium of this species of the Dematiaceae not only invades the tissues of the mature receptacles, but is constantly present also in the small fallen syconiae.

The author has easily made an artificial culture of the parasite. This, taken from a pure culture and from infected receptacles, was inoculated, with positive results, on sound syconiae. Two successive treatments, made at an interval of twelve days, one after another, with neutral Bordeaux mixture, at strengths of 0.5 and 1. % respectively, arrested infection, allowing perfect ripening of the few receptacles remaining on the tree. In February 1924, the author also carried out a winter treatment with mixture at a strength of 2.5 %, after which the tree was in a very good condition of growth. G. T.

(1) See also *R.* 1923, No. 810. (*Ed.*)

212. **The "Ink Disease" of the Chestnut (*Blepharospora cambivora*), in Corsica.**

DUFFRENOY J. Maladie des Châtaigniers en Corse. *Revue des Eaux et Forêts*, Vol. LXIII, VIth. Ser. Year 23, No. 4, pp. 149-156, 6 fig. Paris, 1925.

For at least twenty years, apparently, the "mal dell'inchiostro" (*Blepharospora cambivora* Petri) has attacked chestnut trees, in Corsica.

It appears that the disease was first observed at Corte whence it very soon spread to the Venaco district, causing the disappearance of the chestnut woods affected.

As regards curative treatment of the diseased trees, in 1923 at Saint-Pierre-de-Venaco, a deep wide notch was cut with an adze near the base of the trunk of a dying chestnut tree; in the spring of 1924 the production of very green and rather abundant foliage was noticed.

At Murato another experiment was made: — all the blackened tissues of the base of the trunk, the collar and the large roots, were removed with the adze; an operation which, according to the author, should be extended to all the trees attacked in the same chestnut wood.

Since the chestnut trees operated on remain exposed to reinfection, it is indispensable to supplement this surgical treatment with a disinfection of the soil with cupric salts. It would also be useful to spread nitrogenous, potassic and phosphatic salts at the roots of the trees.

It appears however better: to fell as soon as possible trees found to be attacked in the middle of a sound chestnut wood, and also to fell, as a precaution, their immediate neighbours, which may be infected without showing symptoms of the disease; to disinfect with cupric salts the stumps and the area where they stood; to disinfect as a preventive the soil at the base of the still sound chestnuts standing near. G. T.

Animal Parasites.

213. **New species of Curculionidae Beetles injurious to Cultivated Plants in Various Countries.**

MARSHALL G. A. K. *Bulletin of Entomological Research*, Vol. XVI, Part 1, pp. 67-75, fig. 2 tab. 1. London, 1925.

Description of the following. Curculionidae beetles: —

(1) *Protostrophus edax* n. sp., injurious to young cotton plants in the Transvaal (White River).

(2) *Prot. lugubris* n. sp., considered injurious to young cotton plants in Natal (Esperanza).

(3) *Prot. mutator* n. sp., injurious to beans in the Cape Province (Somerset East).

(4) *Prot. vorax* n. sp., the adult beetles have damaged young cotton plants in the Transvaal (Rustenburg).

(5) *Prot. rotundus* n. sp., has completely destroyed 200 acres of maize and 50 acres of millet in the Transvaal.

(6) *Mecostylus acuminatus* n. sp., living on the leaves of the coffee shrub in Kenya (Teita Hills, near Voi).

(7) *Sympiezotrachelus impar*, n. sp., the adults have been found on the leaves of sugar cane in Natal (Mount Edgecombe).

(8) *Echinocnemus oryzae* n.sp., the larva feeds on the rootlets of the rice plant in Madras (Kaikalur, Krishna district; Samalkot; Thurumella, Guntur district).

(9) *Anthonomus cyprius* n. sp., bred on peach buds in the Island of Cyprus. G. T.

214. **New Curculionidae attacking Trees in India.**

MARSHALL G. A. K. *Bulletin of Entomological Research*, Vol. XV, part 4, pp. 339-344, 1 table, London, 1925

Description of the following species of Curculionid Coleoptera :

(1) *Corigetus instabilis* n. sp. The adults were found attacking the leaves of *Casuarina equisetifolia* trees in Kanara (Bombay)

(2) *Magdalis hymalayana* n. sp., observed in different parts of the United Provinces (Dharmoli, Kumaon, Kanasar, Chakrata) ; the specimens from Kanasar were obtained from *Pinus longifolia* ;

(3) *Camptorrhinus mangiferae*, n. sp., observed in Bihar and Orissa (Koina-River, Singbhum) ; the insect was found on mango trees (*Mangifera indica*) ;

(4) *Phylaitis pterospermi* n. sp., observed in the United Provinces (Golatappar, Dehra Dun) ; obtained from the wood of the *Pterospermum acerifolium* ;

(5) *P. scutellaris* n. sp., observed in the United Provinces (Riverain Forest, Nagsidh, Dehra, Dun), where it was found on *Eugenia Jambolana* ; Lachiwala Range (Dehra Dun), where it was found on *Acacia pennata* ; in Bombay Presidency, at Kasik where it was reared on the *Cassia auriculata*. G. T.

215. **Rhyncotes of the Island of Cuba.**

METCALF Z. P. and BRUNER S. C. Notes and Descriptions of the Cercopidae of Cuba. *Psyche*, Vol. XXXII, No. 2, pp. 95-105. Boston, Mass, 1925,

This is the first of a series of works on the *Homoptera* (sub-order of the Rhyncotes) collected during the last eight years in various localities in the Island of Cuba, by BRUNER, of the Agricultural Experimental Station of Santiago de las Vegas.

Fifteen species and one variety belonging of the family *Cercopidae* are dealt with in it. One genus (*Dasyoptera*) and twelve species (*D. variegata, Monecphora flavifascia, Leocomia grisea, L. balloni, L. nagua, L. maestralis, L. pileae, L. fulva, Enocomia maestralis, Lepyronia robusta, Clastoptera flavidorsa* and *C. cuba*) are described as new to science.

It is to be noted that *Monecphora bicincta* Say var. *fraterna* Uhler (= *M. fraterna* Uhler), common in the Island, damages *Panicum numidianum* (popularly called " Parana ") and sometimes attacks sugar cane.

M. flavifascia n. sp. may prove important from an economical point of view as a pest of sugarcane. G. T.

216. ***Eburia quadrigeminata*, a Coleopteron of North America reported in Algiers.**

BALACHOWSKY A. Note sur la présence accidentelle de l'*Eburia quadrigeminata* (Say, 1827) Coléoptère Cerambycide de l'Amérique du Nord à Alger. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord,* Vol. XVI, No. *LLL*, p. 107. Algiers, 1925.

In June, 1924, there was captured at Algiers an individual of *Eburia quadrigeminata* Say, a *Cerambycidae* Coleopteron long known in the United States and Canada, where its larva lives, boring galleries in the wood of oak, chestnut and ash trees.

The presence of the insect in Algiers is altogether exceptional: in the author's opinion it has certainly been introduced by means of American woods; it seems very improbable that the species can continue to exist in that Colony. G. T.

217. **Observations made in England regarding the Cherry Black Fly (*Myzus cerasi*).**

WIMSHURST F. M. *Bulletin of Entomological Research,* Vol. XVI, Part 1, pp. 85-94, fig. 6. London, 1925.

Though *Myzus cerasi* shows itself to be sometimes a serious pest of the cherry and has therefore acquired economic importance in Great Britain, its biology has not yet been completely studied in the eastern hemisphere. The author gives in the present work a systematic description of the forms of the insect found in Kent (England) — where this Aphid lives on *Galium Aparine* as well as on the cherry — it is an account of biological observations made there during two years on *M. cerasi*. There follows a list of natural enemies of the latter, observed by the author in the above mentioned district. G. T.

218. ***Aphis leguminosae*, Agent of Transmission of a "Rosette" Disease of the Ground Nut, in South Africa.**

STOREY H. H. and BOTTOMLEY A. M. *Nature,* Vol. 116, No. 2907, pp. 97-98. London, 1925.

During recent years the cultivation of the ground nut (*Arachis hypogaea*), in certain localities of South Africa has been seriously affected by the appearance of a disease, locally known under the name of "Rosette". The leaves of the plants affected are small, contorted, closely congested owing to lack of elongation of the stalk, generally yellow, and in many cases showing well defined variegations. No seed is borne by a plant diseased in the first stage of growth and the crop is materially reduced by a late infection.

The nature of this disease remained obscure for a long time. Recently pathologists have generally admitted that the "rosette" of the ground nut belonged to the virus group of diseases. In support of this view now comes in the experimental transmission of the disease: researches carried out at Pretoria and at Durban, have proved the capacity of *Aphis leguminosae* Theo. for transmitting the disease.

In these experiments, specimens of the Aphid taken on plants affected with " Rosette ", were placed to feed on a single mature leaf of a healthy plant, suitably protected from attacks of all other insects. The characteristic symptoms of " Rosette " then appeared in the young leaves of a great number of these plants. The control plants, treated in an identical manner but protected from the attack of insects, remained perfectly healthy.

During these researches a collection was made of all sucking insects present in the field on the diseased ground nut plants. Experiments made with over two hundred specimens of Jassidae and Fulgoridae, belonging to at least eight species, have not enabled even one case of infection to be obtained on the plants subjected to the experiment. G. T.

219. **Ants Injurious to the " Stick-Lac " Cochineal Insect in Cambodia.**

BATHELLIER J. Observations sur les prédateurs des cochenilles à stick-lac. *Bulletin économique de l'Indochine*, New Series, 29th Year, No. 170, pp. 59-66. Hanoi, 1925.

Three species of ants are serious enemies to the cochineal insect, which produces stick-lac, in Cambodia. The author has been able to identify them as : (1) *Crematogaster walshi* Forel, of the subfamily of *Myrmicinae* : this is the most injurious, and is called by the Cambodians " tailed ant " ; (2) *Camponotus* sp. also very injurious ; (3) *C. rufuglaucus* Jordon, of the sub-family of *Camponotinae*.

Oecophylla smaragdina F. protects the cochineal insect against the attacks of the other ants.

In order to prevent the damage caused by the latter, the author commends the smearing of gluey solutions around the trunk of the trees on which the " stick-lac " cochineal insect is reared. P. C.

220. ***Gracilaria zachrysa*, Microlepidopter injurious to Azaleas in France.**

LE MARCHAND S. Note sur la présence en France de *Gracilaria zachrysa* Meyrick, Microlépidoptère exotique, nuisible aux Azalées. *Bulletin de la Société entomologique de France*, No. 9, pp. 146-150. Paris, 1925.

Gracilaria zachrysa Meyr., described in 1907 as a native species of Ceylon, was observed in 1912 in Holland, and in the following year in Belgium, on Azaleas (particularly *Azalea indica*) imported from Japan. In consequence, the presence of the Microlepidopteron was noted in only three Departments in France on azaleas sent from Belgium to Saint-Saens (Seine-Inférieure) some years ago, at Paris (Seine) and at Bayeux (Calvados) in January 1925. But it may be presumed that the species is already fairly common in France. The azaleas sold there by horticulturists come almost exclusively from Belgium, where they are grown on a large scale. It is therefore possible that wherever in France azaleas have been received from Belgium, this insect will be found in smaller or larger numbers.

The caterpillar of *G. zachrysa* attacks the host plant and sometimes disfigures it considerably, boring galleries in the leaves, bending or actually twisting the margins or the end of the leaf.

The observations made by the author regarding the morphology and biology of the insect are described. G. T.

221. ***Coelaenomenodera elaeidis*, a Beetle injurious to the Oil Palm (*Elaeis guineensis*), on the Gold Coast (West Africa)** (1).

COTTERELL G. S. The Hispid Leaf miner (*Coelaenomenodera elaeidis*, Maul) of the Oil Palm (*Elaeis guineensis* Jacq.) on the Gold Coast. *Bulletin of Entomological Research*, Vol. XVI, Part 1, pp. 77-83, fig. 5. London, 1925.

The Oil Palm (*Elaeis guineensis*), at intervals in various parts of the Gold Coast, has suffered from attacks of the beetle *Coelaenomenodera elaeidis* Maul. (fam. Hispidae).

This beetle was noted for the first time in this Colony in 1909-1920, but the damage of the parasite was arrested by the sudden arrival of the rainy season. It was again observed as injurious in 1919; then again the rainy season put an end to its damage. Fresh attacks occurred in 1923 and lasted until January 1924, when they were arrested by natural causes.

The insect attacks oil palms of all ages except those under three or four years. The young fronds of the host plant are attacked almost before they unfold and the larva of the beetle bores galleries under the epidermis. The young fronds are very soon corroded and torn from the rachis by the wind.

A badly attacked palm has an aspect similar to that of a plant which has suffered from the action of fire. Naturally, consequent on the attack, the product of the palm is reduced and the palm itself loses vigour. The larvae of *C. elaeidis* live also at the expense of the coconut palm, *Borassus*, and some ornamental palms. The adult insects also feed on these, and still other plants; they attack the lower surface of the young fronds of the oil palm, devouring the parenchyma between the nerves and leave brown longitudinal incisions on the fronds themselves. Observations made at the Aburi Agricultural Station regarding the biolology of the beetle are separately reported by the author. Its complete cycle of development occupies about thirteen or fourteen weeks.

Four Hymenoptera (fam. *Eulophidae*) natural enemies of *C. elaeidis* were obtained by breeding, namely, *Closterocerus africanus* Wtstn. and *Achrysocharis leptocerus* Wtstn. parasites on the egg, *Dimmockia aburiana* Wtstn. parasites of the larvae. The two latter are in turn preyed on by a Hymenopteron belonging to the same fam. *Eulophidae* (*Pleurotropis nigripes* Wtstn). *C. elaeidis* is also attacked in nature by parasitic fungi which are common on account of the great humidity. The rain also serves as a check on the development of the beetle, which owing to the high numbers of its parasites is not likely to become a real scourge for oil palms.

In the present conditions of the Colony the application of artificial measures of control against *C. elaeidis* is not possible. G. T.

(1) See also *R.* 1920, No. 605. (*Ed.*).

CURRENT NOTICES

Legislative and Administrative Measures.

222. **Legislation with respect to the Importation and Exportation of Plants in Various States.** — The Legislative Section of the International Institute of Agriculture sets forth by means of a short series of publications, the current legislation passed in the various States for regulating the importation, exportation and transport of plants. Each monograph deals first with the legislative sources of the information in question, and then goes on to deal with the organisation of the national services responsible for the application of the measures in question. (*Institut International d'Agriculture. Exposé de la Législation relative à l'importation et à l'exportation des plantes*).

223. **Austria: Regulation of the Trade in Chemical Fertilisers.** — To meet the difficulties of the marketing of these fertilisers and to protect the farmer against commercial frauds, the Federal Minister of Agriculture and Forestry for Austria has issued a decree which lays down special rules for the trade in the products in question. The terms of the decree cover all materials which are not the immediate product of the farm, but which on account of their content in nitrogen, phosphoric acid, potash, lime and other chemical constituents are placed on the market as artificial fertilisers. These artificial manures may be put up for sale only after declaration of their properties and of the weight of their effective chemical constituents. Generally speaking the declaration, in addition to the usual commercial indications, must contain information on the value in fertilising substances and on the form in which they are found in the products as placed on the market.

In the case of calcareous fertilisers the grade of fineness must also be indicated and in that of fertilising mixtures, the nature of the blend and the form under which the effective constituents are present. In the case of those products that are placed on the market with the indication that, in addition to their usual commercial value, they are in some special way favourable to plant development, the nature and character of this particular action must be clearly indicated.

Declarations are regarded as valid if the differences do not exceed one per cent. and in the case of nitrogenous fertilisers one half per cent. of the true content in fertilising substances.

The political and district authorities and the Agricultural Experiment Stations are responsible for supervising the application of the measures enacted. The Stations are also authorised to take samples for analysis and to make

use of a staff sworn in for the purpose and subjected to professional secrecy. (*Bundesgesetzblatt*, No. 88, 1925).

224. **Austria: Regulation of the Trade in Forest Seeds.** — With the object of protecting trade in these seeds, the Austrian Federal Ministry of Agriculture and Forestry has published an order placing the trade under certain restrictions and making compulsory the declaration of the origin of the seeds offered for sale. The order relates to the seeds of the most important forest species. Within the area of the Federal territory the seeds can only be transported in sealed packets and accompanied by a statement of all data required, in particular of the kind of the seeds, their weight and the time at which they were gathered. In addition for the oaks and the conifers statements must also be made as to the percentage of germinability and purity, and of place of origin. In the case of certain forest species special declarations are also required as to the conditions of the soil in the place of origin and on the actual origin of the seeds. (*Bundesgesetzblatt*, No. 249, 1925).

225. **Brazil: Exemption from State Taxes in the State of Bahia for Producers of Oil-seeds, resins and wax and for cotton cloth factories.** — The following are exempted from all State taxes, with the exception of the territorial tax, for ten years from 7 August 1925: 1. All factories set up for the utilisation of oil seeds, of animal and vegetable wax and resins, for the manufacture of oils of vegetable butters and margarine, and for the improvement of such products and the utilisation of the by-products. 2. All cotton cloth factories, set up in the State cotton centres, provided that at least half of the raw material utilised is produced within the State. This exemption is also extended to the buildings, vehicles and raw materials, etc. in use. (*Boletim do Ministerio da Agricultura, Industria e Commercio*, September 1925, Rio de Janeiro).

226 **Brazil: Concession of Lands for Rubber Cultivation in the State of Parà.** — A State decree has been issued for encouraging improvement of lands by means of agreements with capitalists and manufacturers, and for the concession of the free utilisation of lands intended for rubber cultivation, up to a maximum of 150,000 hectares per lot, and for the period required for the manufacture. The lands so granted shall become the absolute property of the grantee, as soon as they are growing more than 100,000 plants of at least five years of age and producing rubber. The State Government is empowered to make other grants of lands intended for the utilisation of the raw materials native to Parà, and for the cultivation of plants of economic value. The area of such concessions must not exceed 50,000 hectares. (*Brasil-Ferro-Carril*, Year XVI, No. 429, 1925).

227. **Spain: Stabilisation of the Grain Market.** — The Ministry of Fomento, with the object of stabilising the national grain market, preventing speculation in grain and enabling farmers to keep it under normal conditions up to the time of the actual sale, has just authorised, in connection with the harvest of 1925, the making of loans to the farmers for an amount equal to half the value of the grain which they have deposited in pledge. A sum of 50,000,000 pesetas is set aside for the purposes of these loans. (*Gaceta de Madrid*, No. 188, 1925).

228. **Finland : Measures for Plant Protection.** — The Ministry of Agriculture of Finland has assumed control of the importation, transit conveyance through the country, cultivation, transportation as also trade in plants or parts of plants infected with pests, or liable to spread infection. These measures are contained in a law of June 1925, and are accompanied by a decree specifying the plant pests which come under this control, and the regulations referring to the control. These regulations also define the procedure for fixing the compensation in the case of any necessary destruction of infected vegetable matter.

229. **France : Phytopathological Inspection of Farm Establishments.** — Under these regulations, all horticultural and viticultural establishments as well as establishments for the export of agricultural products have been assigned, taking into consideration any previous decrees, among the twenty seven existing areas for phytopathological control. (*Journal Officiel*, 5 January 1926).

230. **France (Regency of Tunis): Measures for the Protection of Growing Crops against Animal and Plant Parasites.** — Amendments have been introduced into the first two articles of the Decree of the Regency, 25 January 1922, and in virtue of these amendments every owner of lands or cultivator must notify the local administrative authorities of any damage done to the crops by parasites, and the Director General of Agriculture, of receiving information from these authorities, may order measures to be taken immediately for the protection of such crops, either destruction of the parasitic pests or destruction of the infected plants, restriction or prohibition of transport of plants or parts of plants which may be the carriers of infection or infestation, etc. The Service of Plant Protection supervises the application of the measures thus prescribed. (*Journal Officiel Tunisien*, No. 46, 1925).

231. **France (Regency of Tunis) : Provisions for Agricultural Credit.** — These provisions are contained in two decrees. By means of one, a public office for agricultural credit is instituted, administered by a Board of Directors and under the control of the Director of the Agricultural Services and of Instruction. This office is empowered to make loans for agricultural improvements, both seasonal loans and loans for long periods. By the terms of the second decree loans are made for long periods in favour of agriculturists who are disabled ex-service men. (*Journal Officiel Tunisien*, Nos. 55, 60, 1925).

232. **Canada : Grain Legislation.** — All trading questions relating to grain have been regulated in considerable detail by the Canadian Government in a law, consisting of 236 articles and divided into four parts, with the short title: 'Canada Grain Act'. A Board of Grain Commissioners is established which within thirty days of the close of the civil year must present a report to the Ministry of Commerce: (*a*) on all matters in connection with the inspection, weighing, storage and transportation of grain; (*b*) on such matters as the Ministry may direct. Under separate headings are set out the duties of inspectors, commercial grades, the grain standards board, the grain survey board : provisions relating to sales, to fees, weighmasters, of-

fences, procedure, Eastern and Western Inspection Divisions, grain from the United States.

One whole part of the law (Part III) is given up to the Western Inspection District (provinces of Manitoba, Saskatchewan, Alberta, British Columbia, North-West Territory, and that part of Ontario that lies to the west of Port Arthur) and deals with the public and private elevators and all operations connected with them, loading platforms, railway cars, commission merchants, etc. (*Statutes of Canada* 15-16 Geo. V., Vols. I-II, 1925: *International Institute of Agriculture, Texts of Laws*, No. 20, 1925).

233. **Union of South Africa: Control of the Export of Fruit and of the Shipment of Fruit at the Union Ports.** — The institution of a Board of Control for this purpose has been authorised by law, such Board to be appointed by the Governor General with the following duties: (*a*) to control the export of fruit and the orders of shipment of fruit at all ports of the Union; (*b*) to call for and to receive from fruit producers estimates and other particulars of their intended exports; (*c*) to call for and to receive from shipowners information respecting the amount of space available on any ship appointed to call at any port of the Union; (*d*) to perform such other functions in respect of the export and shipment of fruit from the Union as may be prescribed by regulation. (*Government Gazette Extraordinary*, No. 1477, 1925).

234. **Union of South Africa: Care of Orchards in South Africa.** — The Governor General of the Union of South Africa has issued a series of measures (*Government Gazette Extraordinary*, No. 1477, 1925) under which every owner of an orchard is required to cleanse such orchard from insect pests. In the event of non-compliance the cleansing is carried out officially by the competent authorities. The Governor General may in case of need also prescribe the technical methods to be followed in such cleansing.

235. **Union of South Africa: Promotion of the Agricultural Industries.** — With this object certain fiscal charges have been introduced which, under certain conditions, shall be imposed on agricultural products, and the receipts from which shall be employed to promote: (*a*) experiments, enquiries, or the diffusion of agricultural information in respect of them; (*b*) the erection or purchase of buildings, lands, live stock, machinery, implements or requisites in view of the objects indicated in paragraph (*a*); (*c*) the most profitable method of sale of produce; (*d*) any other subsidiary to the purposes contemplated in paragraphs *a*, *b*, *c*; and finally (*e*) any further aid which in the opinion of the Minister of Agriculture is required for the advancement of agriculture. (*The Union of South Africa Government Gazette Extraordinary*, No. 1489, 1925).

236. **Union of South Africa: Regulation of the sale by public auction as well as certain transactions in livestock, and other agricultural products.** — The rules issued constitute a regulation of sales by auction or sales not effected by private treaty of live stock, wool, hides, mohair, shins, cotton, sugar and other products of sugar cane, and ostrich feathers. (*The Union of South Africa Government Gazette Extraordinary*, No. 1493, 1925).

237. **Irish Free State: Law on Breeding of Cattle.** — In a series of articles strict regulations are laid down as regards breeding arrangements which

can only be carried out after a permit has been obtained from the Ministry of Agriculture. This permit is only given after taking the opinion of an expert committee. (*International Institute of Agriculture. Texts of Laws*, 1925, No. 32).

238. **Italy: Measures for the Repression of Fraud in the Preparation and Trade in the substances employed in agriculture, and in that of agricultural products.** — In different chapters of a Decree Law published in No. 281 of the *Gazzetta Ufficiale* of 1925 there are contained measures for the repression of frauds in fertilisers, spraying and dusting materials, forage and seeds: in wines; vineyard; oils; in butter and lard; in cheeses; in syrups and preserves.

239. **Italy: Measures for the Protection of Apiculture.** — Under a decree law the formation of provincial consortia is being contemplated, consisting of owners of hives, supported if necessary by the Provincial Agricultural Councils and in case of need made compulsory whenever apiculture has in any given province special importance. These consortia may in their turn be linked up with larger interprovincial consortia within the area of the same region. Their main work will be the supervision through specially appointed experts, of all matters connected with the control of bee diseases and pests; the diffusion among agriculturists of the knowledge of the proper measures of control; the diffusion of the regional methods for bee-keeping, with special attention to the purity and careful selection of Ligurian bees; the protection of the economic interests of the apiculturists, of the trade and industry in bee-keeping, and the taking of steps to prevent frauds.

The Decree law lays down regulations as regards prophylactic measures and the control of the infectious diseases of bees, ordering in case of need the destruction of hives and of infected utensils. No compensation is due to the apiculturists in respect of such destruction, but the consortia may guarantee a partial compensation payment, under the form of insurance. A special article deals with the trade in honey and in this connection provision is made for the taking of samples to establish purity by means of analysis. (*Gazzetta Ufficiale*, No. 281, 1925).

240. **Italy (Eritrea): Regulations for Cotton-Growing.** — The Governor of this Colony, by the decree of 22 June 1925, enacts that in certain zones of the Western and Eastern lowlands the cotton plants must be grubbed up and destroyed by fire as soon as the picking is over. The Agricultural Office will each year fix the date by which the fields must be cleared of the residues of the crop. In the case of non compliance by the grower, the Government will undertake the clearing of the fields at the expense of the growers.

241. **Japan: Breeding of Cattle.** — In the official Japanese Gazette, *Kwampô*, a law was published in June 1925, on the free loaning of service bulls by the Zootechnical Experiment Stations (*Chikusanshikenjô*), with the object of promoting the improvement and diffusion of the breeds of cattle. The loan is made to the prefecture, to the breed associations (*chikusan-Kumiai*) and to the federations of these associations (*chikusan-Kumiai rengôkwai*).

242. **Japan: Order relating to the Establishment of the Ministry of Agriculture and Forests.** — These are contained in *Kwampô*,

No. 3779, 1925. In virtue of this order the Ministry of Agriculture and Commerce is abolished and there is created a Ministry of Agriculture and Forestry, including four general departments: agriculture (*nômul-Kyoku*), animal husbandry (*chikusan-Kyoku*), forests (*sangin-Kyoku*) and water cultivation (*suisan-Kyoku*). The Ministry has power to set up special offices for rice cultivation (*beikoku-jimusha*) in the localities in which it is deemed necessary. The General Department for agriculture includes the following sections: agricultural policy, agricultural production, sericulture, agricultural industries, co-operation, cultivated lands, rice cultivation, accounting. The Forestry Department includes two sections: forestry administration and sylviculture; that of water cultivation also two sections: fisheries and aquatic production; the Zootechnical Department three sections: zootechnical policy, horse breeding, cattle breeding. (*International Institute of Agriculture. Textes of Laws*, No. 8, 1925).

243. **Switzerland: Encouragement of Cereal Cultivation.** — The Federal Bank supplies the funds for the milling premiums established by the Federal Decree of 20 June 1924, which annuls the former Federal Decree of 1 July 1922 intended to encourage the cultivation of cereals. Every producer in Switzerland, who uses cereals grown by himself for the feeding of his own family in bread and flour, has the right to a milling premium of 5 francs per 100 kg. of grain (wheat, rye, spelt, maize, and in the mountain districts, barley). For the mountain districst, i. e. 800 metres and upwards, the premium is increased by an extra sum which may amount to a maximum of 3 francs per quintal of grain. For the purposes of the premium the gleaners are reckoned as direct producers. Producers wishing to benefit by this measure or to surrender on favourable terms the quantities of grain which are in excess of their domestic needs, as also the millers who grind the grains in respect of which the premium is paid, must allow the inspecting bodies of the Federal Grain Control free access to the warehouses or farm premises. Whenever the producer wishes to sell to the Government, on favourable terms, the surplus of his domestic requirements in grain, he must first of all provide on general lines for these requirements, making use of the grain which he has himself grown. (*Recueil des Lois Fédérales*, No. 9 and 16, 1925).

244. **Switzerland: Legislative Measures on Sport and the Protection of Birds.** — These are contained in a Federal Law of 10 June 1925 and in regulations for its application issued on 25 November of the same year. Under separate headings the following subjects are dealt with: sporting rights, the practice of shooting, etc., the species of birds, etc., protected, periods for shooting in the localities for which permits may be given, periods for shooting on land rented for shooting: protection of wild animals and birds, protection against losses caused by wild animals, police rules, penalties, temporary and permanent provisions.

The regulations came into force on 1 January 1926 (*Recueil des Lois Fédérales*, No. 32, 1925).

245. **Switzerland: Regulations for preventing the Contamination of Water Courses.** — Special provisions in connection with the Federal law on fisheries of 21 December 1888, have been issued in Switzerland under which it is absolutely forbidden to place in waters populated by fish refuse

matter likely in any way to injure the fish and to prevent their propagation. Solid and liquid waste material coming from farms of any kind cannot be placed in such water courses unless a permit has previously been obtained from the Competent Cantonal Authority as well as approval from the Federal Department for the Interior. Permits cannot be obtained in respect of waste water until they have been purified by suitable processes such as sedimentation, filtration, precipitation, dilution or biological processes, prescribed by and under the inspection of the authority mentioned. This body will determine the measures of protection to be applied in the case of industrial canals communicating with public water stocked with fish and in any case any fishery rights which may exist in regard to the canal waters in question are taken into account. The above mentioned provisions came into force from 1st June 1925. (*Recueil des Lois Fédérales*, No. 11, 1925).

Experiment Stations and Agricultural Instruction.

246. **Argentina : The Agricultural Information and Propaganda Service at the Ministry of Agriculture.** — This service issues propaganda leaflets which are sent to agriculturists who make application on a special form to the *Ministerio de Agricultura, Sede de Propaganda e Informes, Paseo Colon 974, Buenos Aires*. They can at the same time apply for the publications which refer to the crops as shown in the form and which are grown by the applicant. The Service periodically publishes the list of its propaganda.

247. **Spain: Encouragement of Enquiries into the Prevention and Cure of the Chestnut Tree Disease at Estremadura.** — *La Real Academia de Ciencias Exactas, Físicas y Naturales de España*, in accordance with a request made by D. VINCENTE PAREDES GUILLÉN, has announced a public competition on the prevention and cure of this disease. A prize of 38,934.75 pesetas is to be awarded and was placed in December 1924 in the Plasencia Savings Bank, and will be increased by interest at 3 % from that date up to the time of the adjudication of the competition.

Theses must be addressed to the above Academy which naturally reserves the right of proceeding to practical demonstrations as to the methods of prevention and cure described before proceeding to make the award. (Communicated to the International Institute of Agriculture).

248. **United States : The fifteenth anniversary of the Connecticut Agricultural Experiment Station :** — This anniversary was celebrated on 12 October 1925 at Newhaven in the presence among others of representatives of the other north east stations, of the Federal Department of Agriculture, of the Association of Agricultural Colleges and of the University of Yale. The Connecticut Station was the first to be founded in America and among its founders were Professor SAMUEL W. JOHNSON of Yale University and Professor W. D. ATWATER of the Wesleyan University. O. JUDD, Editor and Proprietor of the *American Agriculturists*, gave a personal contribution of 1000 dollars as a contribution to this Institution and the Wesleyan University placed at its disposal its own chemical laboratory, both these offers being made under the condition of a Government grant of 5600

dollars for the first two years. A decree of 2 July 1875 set aside this sum for the purpose and ATWATER was appointed as Director of the new station which was situated at Middletown. At the expiration of the two years a further annual and permanent grant of 5000 dollars was decreed and in this way it was possible to organise the station under Government inspection with Professor JOHNSON as Director and with headquarters at Newhaven, with the use of the laboratories of the Sheffield Scientific School.

Other States followed the example of Connecticut and in this way by means of legislative measures there were quickly established the experiment station of North Carolina (1877), of New Jersey (1880) and Massachusetts, of the New York State and of Ohio State (1882). (*Experiment Station Record*, No. 53, No. 7, Washington, 1925).

249. **United States: The Boyce Thompson Institute for Plant Research, Yonkers, N. Y.** — A note of the foundation of this Institute was given in a previous number of this Review (see Current Notices of No. 2 of 1925). There have now appeared two series of publications, one entitled "Original Contributions" and the other "Professional Papers", consisting of separate articles which have appeared in technical and commercial journals; the paging however is so arranged that the professional papers could be collected conveniently into one volume corresponding with the contributions. The publications will represent the activity of the various sections of the Institute, including the sections of physics and chemistry, bio-chemistry, micro-chemistry, morphology, physiology and pathology.

250. **France: Vocational School for Shepherds at Rambouillet.** — *The Bergerie Nationale* consists of an area of 250 hectares in the midst of the forest of Rambouillet and supports a pure-bred flock of Spanish merinos. The first animals of this flock (315 ewes and 41 rams) were imported from the province of Leon (Spain) as early as 1786, and the breed is considered as being one of the most important wool-producing breeds in the world. A large number of the progeny of the original flock have been exported and the breed has thus been established in all the continents. The flock at Rambouillet numbers 200 ewes and 200 rams of pure strain. These form three very hardy types which show resistance to all conditions of feeding and to every difference of climate.

The school for shepherds, at present under the direction of Prof. A. E. HILSONT, was opened as long ago as 1874, but was closed in 1895, because the pupils, who were taken at the age of 12, were too young to gain any permanent benefit from it. It was re-opened in 1922. Pupils must now be at least fifteen years old on entering, preference being given to those who have already completed their military service. The school is open from August until Christmas. The number of pupils may not exceed 15. This year the course will last 10 months so that the pupils may have practical experience in all the work connected with sheep-rearing, in shearing and in the slipping of lambs. Every day two hours and a half of theoretical instruction is given. The rest of the day is devoted to practical work among the Rambouillet merino sheep and the flocks for killing which Prof. Hilsont wishes to establish and which include already the Dishley Merinos and the Berrichons.

The course in sheep rearing is conducted by the director of the school

himself and includes the method of classification by points, feeding, the study of wool, animal husbandry, the building of sheep pens, a knowledge of sheep dogs and many other subjects. Another teacher gives lessons in veterinary medicine in its application to sheep; a third teaches French, geometry and a little arithmetic.

The head-shepherd and his two assistants undertake the practical instruction. The other part, strictly zootechnical, also includes work in wood and iron and visits to breeding pens and slaughter-houses in the neighbourhood. A Committee of inspection undertakes the general improvement of the school. At the head of this is the Inspector General of Agriculture. It also includes a representative of the Colonial Department, a delegate of the Tourcoing Chamber of Commerce (one of the greatest centres of the wool-industry in the north of France) and five sheep-breeders from the five wool-producing districts of the country.

There is a museum attached to the school which contains samples of wool from all parts of the world and in particular the collection of Rambouillet wool taken regularly from ewes and rams of from 3 to 5 years of age, since 1786. (F. R. ARNOLD. La Ferme et l'Ecole nationale de bergerie de Rambouillet. *La Vie Agricole et Rurale*, Year 14, vol. XXVII, No. 45. Paris 1925).

251. **France: Vocational School for Millers and Bakers.** — The object of this school which was opened in Paris on the 13th of October, 1924, under the direction of M. R. WALTERSPILER, is to turn out practical workmen perfectly acquainted with the various operations of milling and mill-engineering, and capable of constructing mills and of introducing useful improvements to their own machinery. *L'Association nationale de la meunerie française* met the expense of the first plant for the institution, while grants from the Undersecretaryship for Technical Instruction, subscriptions and school fees ensured its continuance. During the school year, that is from October until July, lecturers of first class standing give classes in the technical process of milling (the study and classification of the various species of cereals, the art of grinding and its improvements through the centuries and the installation and equipment of the modern mill); teaching is also given in chemistry as applied to milling (the chemical components and the food value of the various parts of a grain of wheat; the division of wheat into hard and soft wheats; the definition and analysis of flour, of potato flour and of starch, etc.).

Specialists in bread-making explain the physical and chemical changes set up during the process, the methods of kneading and the care of the oven. The rudiments of microbiology (moulds, fermentations, diastasis, vitamins) are imparted by biologists. Instruction is also given in entomology as applied to cereals, to flour and to bread, in the use of hydraulic motor engines, in the custom house regulations, commercial law and book-keeping. The pupils do practical work at the mill of the *Assistance Publique*, Paris and pay visits to other mills, to bakeries and to manufacturies. Examinations in these theoretical and practical studies are held regularly at the end of the school year. Successful candidates receive a diploma in mill-engineering awarded by the Undersecretaryship for Technical Instruction. In addition to the administrative offices and classrooms, the School also includes two

laboratories, one for the pupils and the other for research. The research work includes a new method of measurement of the moisture contained in a grain of corn. There is also a miniature mill, and four electrical kneading machines, each one capable of working from 2 to 3 kilograms of flour and an oven for baking bread, heated by gas and equipped with a nitrogen pyrometer according to the RICHARD system.

In the research laboratory, directed by Mlle M. T. PECAUD, studies are being made in regard to the improvement of the quality of the French wheat strains which are found unsatisfactory by bakers. (J. BOYER, L'Ecole française de meunerie. *La Nature*, No. 2693. Paris, 1925).

252. **France: The New Laboratoire d'Agronomie Coloniale, at Paris.** — In a previous number of the present Review (October-December 1925, No. 913), mention was made of the fire which partially destroyed this valuable laboratory. A committee to discuss reconstruction measures was quickly formed, the moving spirit being M. AUGUSTE CHEVALIER, director of the Laboratoire. *L'Académie des Sciences Coloniales*, on the proposal of the president G. HANOTAUX, and of the permanent secretary, P. BOURDARIE, took the initiative of opening a subscription list for the necessary funds, in conjunction with the *Association française pour l'avancement des Sciences*. The restoration and re-equipment of the laboratory may now be said to be an accomplished fact, as a result of the work carried out with funds raised by the appeal to which there was a generous response. For the actual wood-work use was made exclusively of different kinds of tropical colonial timbers from Central Africa. It only remains to replace the scientific material, books, specimens, etc., which were so disastrously lost in the fire. Suitable publications are constantly being sent from all quarters to the new Laboratory, but the committee will gladly receive books and pamphlets dealing particularly with applied botany, botanical geography, plant selection and genetics, soil science, phytopathology, forestry, horticulture, timbers, and tropical and sub-tropical agriculture.

Donations may be sent post-free from the greater number of countries and should be addressed to M. le Ministre de l'Instruction Publique, Direction de l'Enseignement Supérieure, 2^{e} Bureau, 110, rue de Grenoble, Paris: marked for the Laboratoire d'Agronomie Coloniale, 57 rue Cuvier, Paris (V^{e}).

253. **France (French Sudan): The Koutiala Experiment Farm.** — A full account of the activities of this Station, which was founded in 1923 by the French Colonial Cotton Association appears in the *Bulletin de l'Association Cotonnière Coloniale*, Year XXIII, No. 72, 1925. A number of illustrations are given.

254. **Great Britain: Publication of the Results of the Work of the Agricultural Research Institutes.** — The Ministry of Agriculture has undertaken to publish a series of monographs, the purpose of which is to give, in the language of every day life, an account of work at the Agricultural Research Institutes of Great Britain, and to explain the bearing of the results of research upon practical agriculture.

The first monograph of this series is entitled "Studies concerning the Handling of Milk" and was prepared by Dr. STENHOUSE WILLIAMS and the staff of the National Institute for Research in Dairying.

The second monograph, written by Dr. F. H. A. MARSHALL and Mr. J. HAMMOND, is based upon research into the physiology of reproduction in farm animals, conducted at the Animal Nutrition Institute at Cambridge. The title of the work is 'The Physiology of Animal Breeding with Special Reference to the Problem of Fertility'. Several other monographs are in course of preparation, including one on Wheat Breeding Investigations at the Plant Breeding Institute, Cambridge, by Professor Sir ROWLAND BIFFEN. (*The Journal of the Ministry of Agriculture*, Vol. XXXII, No. 9, London, 1925).

255. **Great Britain: The Cotton Growing Experiment Stations in the British Possessions.** — The Empire Cotton Growing Corporation has published Reports on progress and activity in the years 1923-24-25 as regards cotton growing at the Barberton Experiment Station (South Africa), in Tanganyika Territory (Mpanganya and Morogoro Stations), in Nyasaland (Makwapala Station), and in the West Indies (St. Vincent Station).

At Barberton the experiment work was directed on the breeding of Jassid resistant cotton. Jassid, or *Chlorita fascialis*, commonly known as a leaf-hopper, is a very small winged bug which breeds on the underside of the leaf and sucks the sap. The plant is most susceptible after the earliest bolls have matured. Resistant types have been raised in India, and it has been found that of the varieties imported into South Africa, the Cambodia shows complete immunity, resistance being largely dependent on the hairiness of the leaf. Experiments in hybridisation and selection are being carried out with an encouraging degree of success. In Tanganyika Territory and in Nyasaland the experimental work has been of a more general character. At St. Vincent interesting variety tests have been carried out aiming at obtaining complete sets of data, as regards development, for the several varieties from the sowing of the seed up to the final production of the yarn. (*Empire Cotton Growing Corporation* 1925. *Reports from South Africa and Other Experiment Stations*, London).

256. **Great Britain: Instruction in the Fermentation Industries.** — The British School of Malting and Brewing and Department of the Bio-Chemistry of Fermentation is attached to the University of Birmingham. The objects of this school are various. Complete courses are given on the fermentation industries, at the end of which a certificate is granted which constitutes a qualification for chemical and bacteriological work in the branches of these industries. There is also a three year course of specialised studies, the theory and practice of brewing, malting and similar industries, at the end of which a diploma is granted. In the first year which is preparatory, instruction is given in the elements of physics, chemistry and botany, more or less comprehensive according to the knowledge of theses subjects already possessed by the students. In the second year the subjects of instruction include organic and inorganic chemistry, with the corresponding laboratory work (with volumetric and gravimetric analysis), mechanics and engineering (motor engines, steam, gas and oil; various filtration systems); geology (especially in relation to the water supply for beer factories); the first elements of the technology of brewing. The third year is devoted to a more exhaustive study of the theory and practice of the browing and malting in-

dustries, following on the fuller treatment of the different branches of biochemistry (enzymes, etc.). Special attention is given to the practical instruction in the fermentation micro-organisms and to the methods of analysis required in the industry (saccaromycetes, moulds; fermentation of the saccharoses; of the maltoses; preparation and use of the BUCHNER-zymase; lactic, butyric, acetic and viscous fermentation; causes of changes set up in the fermentation processes of beer, etc.). Detailed explanations are also given of the technique of malting and brewing with accounts of the various systems in use in these industries.

Short courses are also held for the benefit of those who cannot take the full three year courses, and in addition short separate courses of lectures are given as well as practical demonstrations on the principles of the industries. The school is admirably well suited to the needs of those who desire to do practical work on chemistry as applied to agriculture to elementary substance, to medicinal substances, to the provision of drinking water and in general to the principles of urban and rural hygiene.

Similar courses to these held by the Birmingham School are also given in London in the Sir John Cass Technical Institute. (*The University of Birmingham, The British School of Malting and Brewing, Regulations and Syllabus, 1925-26. The Sir John Cass Technical Institute, Department of the Fermentation Industries, Syllabus of Classes, Session 1925-26*).

257. **Great Britain: Organisation of Scientific Research in the British Empire.** — In the course of a speech delivered on 4 November 1925, to the Royal Society of Arts, London, Sir THOMAS HOLLAND dealt with the voluntary associations, the national associations and the overseas organisations, as well as the Imperial Bureaux, especially those of Entomology and Mycology, the Trades' Research Associations, including the Empire Cotton Growing Corporation. At the conclusion of his speech the speaker emphasised the work which is being carried out by the National Research Council in the United States of America. (*Journal of Royal Society of Arts*, Vol. LXXIV, No. 3809, London, 1925).

258. **Great Britain: A Cotton Research Station at Trinidad.** — This is to be organised by the Empire Cotton Growing Corporation at the Imperial College of Tropical Agriculture. It will be adequately staffed and endowed with funds for the purposes of research into the development, under carefully controlled conditions of the cotton plant in all its phases, so as to ascertain and estimate the importance of the different factors which contribute to the final result of this development (*Nature*. Vol. 116, No. 2918, 1925).

259. **Great Britain: The Agricultural College at Reduit, Mauritius.** — This institution originated in the training of students at the Reduit *Station Agronomique* which was enlarged and extended to form a School of Agriculture at the time of the establishment of the Department of Agriculture in 1913. The Agricultural College is the result of the further development of this undertaking, and was inaugurated in 1923 and administered as a branch of the Department of Agriculture. The accommodation includes well equipped laboratories for the teaching of Chemistry, Physics, Botany, Entomology and Sugar Technology, a library and museum, and there are

attached experimental fields, nurseries and a stock farm. It is intended at a later date to provide facilities for practical studies in relation to sugar manufacture.

Various courses are provided by the College, usually covering a period of three years, and designed according to the special purpose the student has in view, whether to obtain a diploma in agriculture, or to become qualified as an agricultural chemist; or as a veterinary surgeon or in sugar technology. (*Colony of Mauritius, Prospectus and Syllabus of Instruction of the College of Agriculture, Mauritius*, 1924-25, Port Louis, 1924).

260. **India: Agricultural Development of the Punjab.** — Last year Sir Ganga Ram, Kt. C. T. E., R. B. in Lahore forwarded to the Governor of the Punjab the sum of 25,000 rupees as a fund the income from which are devoted to the award of a prize to be given every three years (*Maynard Ganga Ram* prize) for any discovery or invention or practical process which proves of value for the development of Agriculture in that vast region. The capital which is invested in the Punjab Charitable Foundations Fund is administered by a special committee. The competition for the first of these prizes falls due on 1st January 1929 and is international in character. The sum to be awarded to the winner of the competition is 3,000 rupees. (Communicated to the International Institute of Agriculture by the Punjab Agricultural Department).

261. **Italy: Encouragement of the Studies of Plant Electro-Genetics.** — *L'Istituto Sperimentale di Elettrogenetica* at Belgirate, Italy, with a view to the encouragement of these enquiries, has announced for competition in 1926 three prizes of 2,500 lire each respectively for the discussion of the three following subjects: *a*) abortive embryo-genesis in the hybridisation of the Angiosperms; (*b*) the origin of the false hybrids in the F_1 dimorphs produced by crossing among pure stocks; (*c*) double fertilisation and the formation of albumin in the hybridisation between species of the agricultural *Gramineae*.

The competition which is open to Italian citizens closes on the 31st December 1926.

262. **Italy: Encouragement of Fruit growing and Horticulture in Emilia and in Romagna.** — The "Cesare Zucchini" Foundation (*see International Review of the Science and Practice of Agriculture* 1924, No. 690) has announced a fourth competition open to Italian citizens and public bodies for the prize of fifteen hundred lire awarded every four years for the best work, discovery, invention, scientific or industrial application of importance to the progress of fruit growing and horticulture in Emilia and Romagna.

The competition closes 31 December 1929. For information, apply: *Fondazione del premio quadriennale perpetuo "Cesare Zucchini"*, Cassa di Risparmio, Bologna.

263. **Italy: A special course on Training in Fisheries** was held in Rome when the II National Meeting of the Consortia of Vocational Schools for maritime skilled labor met in April last. The course was subdivided in three groups: technical-scientific, social-economic, juridical-legislative.

The first group dealt with: Lagoon and salt water fish (Prof. G. BRU-

NELLI); Migration of eels and sturgeons (Dr. T. CHIAPPI); Biology of tunny-fish (Prof. L. SANZO); Methods and Means of fishing (Prof. E. F. CANNAVIELLO); Motor fishing (Capt. M. FUSCO); Fishing and industrial impurities (Dr. C. MALDURA); Sponge fishing in Tripolitania (Prof. M. SELLA); Weather forecasts and navigation (Prof. F. EREDIA).

The second group held seven conferences: Emigration and Fishing in Eastern Mediterranean (Dr. E. NINNI); Management of large Fish Markets (Prof. G. PARDO); Organisation of fishermen's syndicates (Capt. G. RICCI); Sanitary assistance to fishermen (Dr. E. DELLA SETA); Invalid Fund in the Mercantile Navy (Dr. G. BRAMBILLA).

The third group delivered three lectures: Elements of Water Police Service (Major L. POSSENTI); The maritime demesne and the fishing industry (Dr. C. TREVES); The lower grades in the fishing and coasting trades (Dr. G. DE ANGELIS). A final lecture was delivered on: The co-operative-school movement and social-ethical education (Prof. D. LEVI MORENOS).

264. **Italy: Courses on Sericulture at the R. Experimental Silkworm Station in Padua** were inaugurated in April last, the following arguments being discussed: Present day problems (Prof. Dr. L. PIGORINI, Director of the Station); Habits and particulars of arthropods and *Bombyx mori* (Prof. Dr. G. TEODORO, Vice-Director of the Station, and Dr. G. TONON); Embryology and morphology of the silkworm (Prof. Dr. G. TEODORO and Dr. G. TONON); Physiology and physiological chemistry of the silkworm (Prof. L. PIGORINI); Physical surroundings in relation to sericulture (Prof. Dr. L. DE MARCHI, Director of the Physical Geography Institute, University of Padua, and Prof. Dr. G. CRESTANI, Director of the Meteorological Observatory of Padua); Microbiology and immunity (Prof. Dr. O. CASAGRANDI, Director of the Hygiene Institute, Padua University); Silkworm Pathology (Prof. L. PIGORINI and Prof. G. TEODORO); Scientific Commercial Characteristics of cocoons and silks (Prof. Dr. G. COLOMBO), Director of the Experimental Silk Station, Milan); Scientific economics of the silkworm and silk industries (Prof. Dr. M. BOLDRINI, Prof. Dr. G. COLOMBO and Dr. R. DI TOCCO); Application to practice (Dr. R. DI TOCCO). At the end of the course, which lasts three months, a Diploma of Producer of Silkworm Seed is granted.

265. **Italy: Institute of Cereal Cultivation, Pisa.** — This new Institute has for its principal object the study and research of the types of wheat most suited to Tuscany and the practical experiments which will contribute to the improvement and increase of production. Prof. AVANZI of the Higher Agricultural Institute, Pisa, has carried on, for the past few years, a notable work of selection and grafting of wheats, arriving at some very satisfactory results. (*L'Italia Agricola*, Year 60, No. 12, Piacenza, 1925).

266. **Italian Somaliland: The Merca Institute for Sero-Vaccination.** — In 1911 the Italian Government instituted in Somaliland a Control Office and a Laboratory for the study of cattle diseases The work developed considerably and in 1915 an Institute for Sero-Vaccination with annexed zootechnic section was founded. This Institute, mainly undertakes the manufacture of rinderpest serum and has made steady progress in this, the output now being sufficient for the requirements of the Colony while its benefits

will before long be extended to the more distant and most nomadic tribes.

The Institute is well fitted for all bacteriological and parasitological research, with a pharmaceutical deposit, refrigerating plant, etc. It effects vaccination as required at stated periods by means of a travelling Section, employing camel transport. The number of cattle vaccinated increased from 2000 to 76840 in 1924-25, and many tribes which had lost practically all their cattle have been able to build up their stock again in a few years. (*Bollettino d'informazioni economiche, Ministero delle Colonie*, XIII No. 4. Roma, 1925).

267. **Italy: Series of Lectures on Agricultural Archaeology in Rome.** — A course of lectures have been given by Ing. GIULIO DEL PELO PARDI in which he stated the results of his enquiries into ancient Italian agriculture. The syllabus was as follows: Introductory lecture :— Agriculture and Civilisation :— Ancient Italian Agriculture and the Early Colonisations: — Early Land Improvements and the Cunicoli of Latium : — hydraulics and irrigation as practised by the ancients (with lantern slides) : literature and treatises on agriculture :— the Latin Georgics :— ancient agrarian terminology, the real meaning of the following: Pomerium, Villa, Hortus, Viridarium, Lucus, Silva, Nemus and Saltus :— Rustic rites and myths of the ancient Latin religion :— Old country festivals :— CATO: *De Re Rustica* — illustrated and explained in the light of modern science.

The course concluded in a most practical manner, by showing how from a sound knowledge of ancient Italian agriculture and a careful interpretation of the ancient Georgics, in particular CATO's *De Re Rustica*, very many valuable hints could be gained as to the application of the agricultural science of our own day.

The lectures were completed by excursions into the Campagna to see existing remains of ancient agricultural and drainage works. Visits were also paid to the demonstration fields, which have been started by the lecturer at the Experimental Institute for Agriculture, Animal Husbandry, and milk production (*Istituto Sperimentale Agrario Zootecnico Lattifero*) at Monte Rotondo, which is utilised, administered and managed by the Ministry of National Economy).

268. **Italy: Institute of Cereal Cultivation in connection with the Bologna Co-operative Society.** — In Italy the improvement of wheat is being studied at the Rieti *Stazione di granicoltura*, and at the *Istituto di cerealicoltura* at Bologna. This latter is under the direction of Prof. F. TODARO and was opened in 1908, and the objects of its work are as follows: 1. to assist in the improvement of breed, with special reference to wheat, of the principal cereals cultivated in Italy; 2. to investigate the conditions of cultivation most suited to each type of wheat; 3. to make each region produce, so far as possible, the seed wheat it requires; 4. to submit the ordinary varieties of wheat to selection whenever it seems advisable; 5. to enable students of the Higher School of Agriculture to complete their phytotechnical studies.

One of the most important departments of the Institute is that of research into the conditions most suited for each type of wheat, with a view to indicating the districts best adapted for the cultivation of a given type. The trading activities of the groups of producers are organised through an

office with headquarters at Piacenza (*Federazione Italiana dei Consorzi Agrari*). These consortia are established in all the regions of Italy by means of the local agricultural lectureships (*Cattedre locali di agricoltura*). In the Consortium of Bologna are included the Institute for Plant Breeding and the Co-operative Society for Seed Production. The varieties selected by the Institute and recognised to be of value are propagated by share-holder cultivators in the different agricultural centres or consortia. The crops are inspected by officials from the Institute who are present at the threshing and at the sealing of the sacks which go to the Society which pays the producer 1 to 2 liras more for the wheat than the maximum market price and later gives, if the seed proves satisfactory, an extra premium to producers.

Among the activities of Prof. TODARO, the following may be mentioned: his investigation of the minor species of wheat, conducted by a process of selection from the cultivated fields of those plants which are distinguished by some special characteristic: sowing and preservation of the finest stocks, seeds from which are issued to members, while the original improved type is always maintained pure. Great importance is attached to early maturity, as, if a late maturing wheat becomes scorched, the grain ripens badly and the cultivator gets no benefit from its yield capacity. Wheats with short straw are preferred as they are less easily laid. MAYLIN describes the different activities of the Institute, the museum, the experimental fields, the farm houses and the different breeds of selected wheat. He arrives at the conclusion that given a climate and geographical conditions similar to those obtaining in the Bologna and Carcassonne (Aude) regions, it would be advisable to try to introduce the varieties of selected wheat to be obtained at the Institute. (MAYLIN M. [Station d'essais des semences de Paris]. L'Institut de céréaliculture de la Société co-opérative bolonaise, pour le production des semences de grande culture. *Ann. de la science agronomique française et étrangère*, Vol. 41, No. 6. Paris, 1925).

269. **Oceania: Pan-Pacific Research Institute at Honolulu, Hawaii.** — The chief object of this Institute, founded by the Pan-Pacific Union, is the consideration of questions connected with the food resources of the countries of the Pacific Coasts. Its work also includes the study of the demographic, ethnographic and health problems af these countries. The Institute is administered by a council, consisting of representatives, elected from each Pacific country. There is also a Board of Governors composed (*a*) of the chairmen of each of the Permanent Committees formed from among the Institute members for the various branches of research; (*b*) of the President of the Science Council of the Pan-Pacific Union; (*c*) of the general director and of the honorary president of the Institute; (*d*) of members elected annually by the Board itself from among the scientists and technicians collaborating in the researches carried on at the Hawai headquarters.

The following studies and enquiries are carried out by the respective permanent committees: the Pacific coasts in general: the food resources of their waters; land cultivation; regional botany, ethnography and demography; questions of health and sanitation; the collection of useful plants in the Pan-Pacific Economic Botanic Garden; animal husbandry; meteorology;

topography; transport and distribution of food stuffs; international legislation to facilitate agreements or treaties encouraging the development, utilisation and preservation of the natural resources (both animal and vegetable) of these regions; agricultural entomology and phytopathology.

Branches of the Institute will be formed in each of the Pacific Countries.

270. **Japan: The Sapporo Agricultural College.** — The Hokkaido Imperial University is the outgrowth of the Sapporo Agricultural College which was founded in 1876. The College itself may again be traced as far back as the spring of 1872. In that year a small preliminary school was started in Tokyo by the Colonial Department of the new Imperial Government with the object of training young men for the work of colonisation in Hokkaido. At the same time it was to serve as a stepping stone to a future higher institution of Agriculture and Engineering. In 1875 the school was removed to Sapporo, Capital of Hokkaido, and was called by the new name of the Sapporo School. Under recommendation of General Horace CAPRON, Commissioner and Adviser of the Colonial Department, the Japanese authorities succeeded in procuring the service of Dr. William SMITH CLARK, President of the Massachusetts Agricultural College, to organise a new higher institution of Agriculture similar in plan and scope to the Agricultural Colleges of the U. S. A. The name of the Sapporo Agricultural College was given to the new institution which was the earliest organ of agricultural higher education ever founded in Japan.

In 1907, the Tohoku Imperial University was opened with two Faculties, one being the College of Agriculture in Sapporo and the other the newly started College of Science in Sendai. Thus the Sapporo Agricultural College became a component part of the Tohoku Imperial University, though only for a short time. In March 1918, the Hokkaido Imperial University was formed by an Imperial Ordinance with the Faculty of Agriculture separated from the Tohoku Imperial University and the newly founded Faculty of Medicine in Sapporo. Preparation for the opening of the Faculty of Engineering is now actively going on.

In December 1922 the teaching staff of the Sapporo College as transformed into the Faculty of Agriculture consisted of 132 persons including lecturers, demonstrators, assistants, etc., giving instruction in 32 subjects. The instruction was divided into six sections: agronomy, agricultural economics, agricultural biology, agricultural chemistry, forestry, and zootechnics and under each subject there is a syllabus of numerous theoretical and practical exercises. Two schools of an entirely practical character have been later added: the School of Practical Agriculture and the School of Practical Forestry, and there is also a School of Fishery.

The Central University Library contained in March 1922, 34,160 Japanese and Chinese books, 38,085 European and American books and 3030 atlases, tables, pictures, etc.; the decimal system has been adopted for classification of the contents.

The Botanic Garden of 30 acres is located near the centre of Sapporo. It has about 6000 plants, foreign as well as indigenous. There is also a museum which was erected 1883; this is open to the public and divided into

four sections : 1, Natural products ; 2, Industry ; 3, History, 4, Books, pictures and photographs. It is celebrated for its valuable collections illustrating the natural history and anthropology of the Hokkaido.

The University demonstration farms are situated in different parts of the Island and cover in all 15,187 acres. There is besides a garden of nine acres. There are four University forests in Hokkaido covering 183.163 acres, one in the island of Saghalin (48,793 acres), one in Korea (63,436 acres), and one in Formosa (16,782 acres).

The School of Fishery has a marine station and laboratory on the shore of a little harbour not far from Sapporo. (The Development of the Hokkaido Imperial University, Sapporo, Japan, 1923).

271. **Russia : Installation of new Meteorological Stations in Mongolia.** — Prof. W. B. SCHOSTAKOWITSCH, director of the Meteorological and Magnetic Observatory at Irkutsk, has organised, for the Government of Mongolia, a well equipped meteorological service. In addition to the Urga Observatory, there are in existence at present seven stations : at Uljassutai, Wangin, Chatyl, Dsain Schabi, Sangin, Ude and San Reisse. These centres of observation were instituted with the support of the Central Geophysical Observatory at Leningrad. (Dr. A. PETERMANN'S, *Mitteilungen aus "Justus Perthes Geographischer Anstalt"*, Year 72, Parts 1-2, Gotha, 1926).

272. **Dutch Indies : Agricultural Research Institutes.** — Dr. P. J. S. CRAMER, director of the Government Agricultural Experiment Station of Buitenzorg, Java, in a concise but full report made to the Pan-Pacific Scientific Council to be held this year in Japan, gives an account of the organisation of the research work, government as well as private, which is being carried on in the Dutch Indies. Among the institutions directly subordinated to the Department of Agriculture are : the Buitenzorg Botanic Garden, directed by Dr. W. M. VAN LEEUWEN, which was founded in 1817, with a park which includes the summit of Mount Pangerango — 3000 m. —, and with an alpine hut at a height of 2400 m. for the study of the mountain flora ; the General Agricultural Experiment Station (Buitenzorg), under the direction of Dr. CRAMER himself ; the Phytopathological Institute, directed by Dr. C. J. J. VAN HALL and including two sections, a botanical and a zoological section, as well as the quarantine inspection service carried out at Tandjong Priok, Semarang, Soerabaja, Makassar and Medan (Belawan) ; the Division of Agricultural Economy, under the direction of Dr. CRAMER ; the Government Experiment Station for the cultivation of quinine, situated in the desmesne plantations of Tjinjirocan, Pengalengan and the neighbourhood of Bandoeng, and directed by Dr. M. KERBOSCH ; the Buitenzorg Agricultural College, under the direction of Dr. TH. VALETON ; the Forestry Research Institute, also at Buitenzorg, under the direction of Dr. R. WIND, and including four sections : timber technology ; forest investigation from the botanical and technical standpoint ; enquiry into the possibilities of re-establishment of forest species (apart from teak); enquiries as to the re-establishment of teak forests and forest protection ; the Buitenzorg Laboratory of Veterinary Research, under the direction of the Veterinary Officer, Dr. C. BUBBERMAN, and including the sections of : general diagnosis, preparation of serums and vaccins, veterinary parasitology, and various kinds of research.

The Magnetic Meteorological Observatory of Batavia, directed by Dr. C. BREAK, is under the Naval Department. A number of flourishing private research institutions also exist in the Dutch Indies: an Experiment Station for the sugar plantations at Pasoroean, with a sub-division at Cheribon; the general Experiment Station of Rubber Planters of the East Coast of Sumatra (A. V. R. O. S.), Kampong Baroc, Medan S. O. K.; the Buitenzorg Central Experiment Station for Rubber (Java); the Institute for Rubber Physiology, also at Buitenzorg; the United States of America Department for experiments on the rubber plantations, in Kisaran, Sumatra; the General Experiment Station for Tea and Rubber of Java region, with headquarters at Buitenzorg; the Scientific Service for the Rubber Plantations of an Amsterdam Company, in the neighbourhood of Medan; the Experiment Station for the rubber of Western Java; the Malang Experiment Station which chiefly deals with coffee and rubber; the Laboratory for the study of the insect *Stephanoderes hampei* Ferr., parasite of the coffee berries, and finally the two Tobacco Experiment Stations at Klaten and Deli (Dr. P. J. S. CRAMER. Institutes for Research Work in the Interest of Agriculture in the Netherlands Indies. *Journal of Pan-Pacific Research*, Vol. I, No. 2. Honolulu, 1925).

273. **Russia: "Dokoutchaev" Soil Science Institute at Leningrad.** — The Soil Science Section of the Permanent Commission for the Study of the natural resources of the U.S.S.R., at the Academy of Science at Leningrad, has been re-named the Soil Science Institute, re-organised and transferred to a large building forming part of the geological museum of this Academy. The Soil Science Museum and special Library, bearing the name of the founder of Russian Soil Science, Prof. V. V. DOKOUTCHAEV, have also been transferred here. The Director of the new Institute is F. LOEWINSON-LESSING, a member of the Academy. (From a circular sent by the Secretariat of the Russian Institute of Soil Science).

274. **Czecho-Slovakia: The Union of Institutes for Agricultural Research.** — This Union includes all the public and private institutions in Czecho-Slovakia interested in the progress of the science and practice of agriculture. Special Sections are formed for the study of particular problems: soil science, seed testing, investigations of fertilisers and on plant nutrition, phytopathology, questions of milk production, etc. Beginning from January of the current year the Union has published a bulletin (*Vestnik vyz kumných ústavu zemědělských*) with a supplement dealing with plant diseases. (Publishing Office: Prague II, Vaclavscké, No. 47). (Communication sent to the International Institute of Agriculture).

275. **Czecho-Slovakia: Instruction in Cheesemaking.** — This instruction is given at special schools, at Frýdlant, founded in 1892, at Plzeň (dating from 1894) and at Kroměřiž founded in 1902, all three being also attended by foreign students. An experimental station and a museum is attached to each school. There are also two other experimental institutes at Prague, one of which is attached to the Higher School of Agriculture while the other belongs to a limited company, which is however under the control of the Ministry of Agriculture.

Cheese manufacture in Czecho-Slovakia is also encouraged by the acti-

vity of bodies of the nature of syndicates with headquarters at Prague, Brno and at Bratislava respectively and are grouped into three co-operative federations. (Publication of the Ministry of Agriculture of the Republic of Czecho-Slovakia, Prague, 1 December 1925).

276. **Czecho-Slovakia: Report of a visit to the Agricultural Institutions.** — Dr. A. MARCELLO DEL MAINO has lately visited the most important of the agricultural institutions of Czecho-Slovakia, obtaining much and varied information especially as regards the cultivation of wheat and of the sugar beet. He is thus in a position to give an account of the work done by the Higher School of Agriculture and Forestry attached to the Grebova Polytechnic, by the Government Stations of Uhrineves (about 575 hectares including 432 of plough land), and of Clumec, directed by Prof. K. KAMENICKY, for the improvement of fruit plants, also of the Brno Experiment Station and the two private stations, namely the one at Clumec for selection and improvement of breeds of wheat, forage plants, and aromatic and medicinal plants, and the Semsice station (near Dobrovice), and finally of the Limited Company for the production of beetroot seed.

The report drawn up by Dr. MARCELLO DEL MAINO presents a summary of the notes which he was able to make on the scientific agricultural methods in use in the Czecho-Slovakian Republic, and conclusions of value are drawn by the author. (Report forwarded by the author to the International Institute of Agriculture).

Agricultural and Scientific Associations and Institutions.

277. **International Scientific Commissions at the International Institute of Agriculture.** — These Commissions are appointed by the Permanent Committee of the International Institute of Agriculture whenever it seems advisable to that Committee to call upon a body of competent persons to study and make decisions on questions coming within the province of the Institute. Each Commission is called upon:

(*a*) to provide the Permanent Committee and the Bureaux of the Institute with advice on all questions submitted to it; (*b*) to present their views of a technical and scientific nature on all questions falling within the competence of the Institute; (*c*) to make recommendations to the Permanent Committee, requesting it to consider or cause to be included in the Agenda for the Commission any question of importance to the progress of the different sciences which have relation to agriculture; (*d*) to establish through its members close relations between the Institute and men of science and scientific institutions, and vice-versa.

The work of each Commission is carried out as follows:— (*a*) by meetings in Rome, summoned on the motion of the Permanent Committee of the Institute; (*b*) by consultation of all or some of the members, according to the nature of the question, by correspondance; by the exchange of suggestion, information and advice, between each member and the Institute.

The various Commissions here referred to will together form the International Scientific Council of the International Institute of Agriculture. (Regulations for the *International Scientific Council of the International Institute of Agriculture*).

278. **China: Foundation of a Natural History Society at Pekin.** — This Society was formed in September 1925, on the initiative of Dr. A. W. GRABAN. Dr. G. D. WILDER was elected President, and after the organisation of the Society was completed, addressed the meeting on the subject of ' Some Common Birds of Pekin, illustrating the lecture by means of a number of mounted specimens of the Chinese birds and coloured plates of a number of closely related American birds. In addition were shown some copies of ancient Chinese paintings of birds. These were so accurate that in many instances the birds can now actually be identified from them. (*Science*, Vol. LXII, No. 1612, 1925).

279. **Hawaii: Honolulu Academy of Sciences.** — The Academy was founded some months ago with a membership of 80. The President is Dr. F. C. NEWCOMBE; Vice-President, Dr. C. MONTAGUE COOKE.

280. **France: A Permanent Committee for Milk Testing.** — This Committee has been established by the *Société nationale d'encouragement à l'agriculture* and is formed by a combination of the Testing associations already in existence. The object of the Committee is to encourage the diffusion of the testing system, and to keep the associations thus combined informed of all that has been done in the matter and of all results obtained with a view to the establishment of further testing work. At the end of 1925, the Committee had extended its work to 13 breeds of cattle and 16 associations were formed for testing of the Norman breeds and 15 for the Flemish breed, whether exclusively, or at the same time as other breeds. (*La Vie Agricole et Rurale*, Year 14, vol. XXVII, No. 49, Paris, 1925).

281. **France: Chambers of Agriculture in the French Establishments in India.** — By a Decree of January last, throughout these Establishments, the Governor has authorised the institution of Chambers of Agriculture for the protection of the agricultural interests of the Region. It is more particularly their duty to supply all information to the Government on the agricultural questions relating to their area, and to give their views as requested; to transmit to the authorities all resolutions which they may pass on any question of agricultural interest; and to carry out any departmental work that may be entrusted to them. These Chambers of Agriculture may be empowered to set up, to administer and to assist with funds within their respective areas, establishments, institutions and services of agricultural value and also any rural undertakings of a collective character. In the event of these undertakings having value both from the agricultural and commercial standpoint, grants may be made to them from the Chambers of Agriculture and the Chambers of Commerce, conjointly. (*Journal Officiel*, 26 January 1926).

282. **Great Britain: The Intelligence Department of the Ministry of Agriculture and Fisheries.** — A report on the work of the Intelligence Department of the Ministry for the three years 1921-24 has been published. It includes the work of agricultural instruction and experimental enquiries with relation to the production of milk, poultry keeping, horticulture and live stock improvement. This publication continues the similar report for the two years 1919-21 which contained a general account of the

policy adopted by the Ministry in agricultural research and education during the period immediately after the War.

The work of the Intelligence Department falls naturally into three main divisions: I. Research; 2. Advisory; 3. Education.

The Research Institutes and Stations of which there are 19 altogether are grouped according to the subject of their investigation and are when possible affiliated to a University.

Five of these Institutes deal with soil and cereal and forage crops, five with horticulture, four with animal pathology, three with animal husbandry, one with agricultural economics and one with agricultural engineering. The Institute of Agricultural Engineering is attached to the *School of Rural Economy at Oxford*. A new Institute of *Animal Pathology* has been founded at Cambridge. Advice on agricultural questions is usually given through the medium of the *County Agricultural Organiser* and his staff who are in direct contact with the farmer. This staff gives advice on matters of every day routine; they are so to speak the general practitioners for agricultural ills. When however they cannot prescribe the treatment themselves they can call in the specialist officers at the agricultural colleges. These Advisory Officers are placed at the centres known as Advisory Centres, generally a University or Agricultural College or a similar institution. The area of administration of these bodies consists of a fixed number of counties which constitute a Provincial area.

The Advisory Officers in Chemistry, Entomology, Mycology, Agricultural Economics, Bacteriology and Veterinary Science thus form a link between the county staffs and the general body of research workers.

Agricultural instruction falls naturally into two main branches: *Higher Instruction* given at the Departments of Agriculture of the Universities, and at the Agricultural Colleges, and providing a two or three year course leading up to a degree or diploma; *Lower Instruction* provided by the local authorities and consisting of yearly courses or lectures on special subjects held at the Farm Institutes. Experimental work and demonstrations are also organised as well as shows and competitions.

These organisations are thus linked with each other by higher councils or committees such as the Research Council which includes all the Directors of the Research Institute, the Animal Diseases Research Committee, the Committee of Advisory Economists. These bodies carry out a work of co-ordination effected partly by the periodical meeting of the Advisory. Officers as well as in Provincial Conferences between the specialist Advisors of a given Advisory Centre and the County Organisers of the Counties belonging to a certain province and Advisory Centre. In addition a Conference of Organisers may also be held at a Research Institute.

The Ministry of Agriculture has the supreme control of all the organisations described.

The report is evidence of the great development of the organisation during the three years under consideration, a development due largely to the large grant made for the purpose. (Report on the Work of the Intelligence Department of the Ministry for the three years 1921-24. H. M. Stationery Office, 163 pp. Price 3/-).

283. **Great Britain: Report of the Fertilisers and Feeding Stuffs Advisory Committee.** — This Committee which was formed by the Ministry of Agriculture and Fisheries in December 1924 has drawn up a detailed report on the following questions into which enquiry has been made:

(*a*) designation of the fertilisers and feeding stuffs to which are applicable all the legislative measures proposed on the basis of the report of the Ministerial Committee on the Fertilisers and Feeding Stuffs Act of 1906; and designations of the fertilisers and feeding stuffs to which on the other hand are applicable only the civil provisions of the same Law;

(*b*) the definition of all the substances or classes of substances under consideration;

(*c*) note on the constituents which must be shown in the invoices and trading descriptions as present or not present in these substances;

(*d*) designation of those substances which are to be considered as either worthless or deleterious, as fertilisers of feeding stuffs.

The Committee could in addition fix the terms to be employed in the trade descriptions and invoices of the substances in question. (Report of the Fertilisers and Feeding Stuffs Advisory Committee. H. M. Stationery Office 36, PP. London. Price 9d).

284. **Great Britain: Veterinary Inspection of 1924.** — The Chief Veterinary Officer of the Ministry, Sir STEWART STOCKMAN has issued a report on the work carried out under the Diseases of Animals Acts. One of the principal headings of this report relates to Foot and Mouth Disease and another chapter to the Supply of Meat by means of the imports of store cattle mainly from Canada, the United States and South Africa. Mention is also made of the transit of stock from Ireland, the import of animals for exhibition and other exceptional purposes and the export of horses to the continent. The work carried on at the ports by the Port Veterinary Officers is described. The report is to be obtained from H. M. Stationery Office, Adastral House, London, W. C. 2, price 1s. 6d. (*The Journal of the Ministry of Agriculture*, vol. XXXII, No. 9, London, 1925).

285. **Tripolitania: Agricultural and Meteorological Services.** — By decrees of June 1925, the Government of this Colony has issued regulations for the: Agricultural Propaganda Office, Travelling Agricultural Professorships, the Experimental Station of Sidi Mesri and the Meteorological Services. The Agricultural Propaganda Office acts principally as advisor to the Colonial Government, controls plant diseases and stock-breeding, affords technical assistance to the agriculturists and stock-breeders of that region. The objects of the Experimental Station of Sidi Mesri are: *a*) the study of agricultural and economic conditions of the Colony in relation to its agricultural development; *b*) the study, through experiments and tests, of the crops best suited to these conditions; *c*) the study and application of the best methods of cultivation; *d*) the selection and improvement of races and varieties of plants and animals, in the strictly agricultural sense as well as in the zootechnical, suited to the climate and local resources; *e*) the carrying out of economic-agricultural experiments. The Meteorological Station is responsible for the daily reports of the meteorological and geophysical observations by the Tripoli Central Observatory, and for receiving

and collating in special publications, all meteorological data from the various Stations in Tripolitania, Cyrenaica and the Central Mediterranean Basin. It assists also the observers in the territory when such assistance is needed. (*Bollettino d'informazioni economiche, Ministero delle Colonie*, Year XIII, No. 4, Rome, 1925).

286. **Japan: The Japanese Association for the Advancement of Science** was founded in April 1925 and held its first meeting at Tokio. Dr. KOZAI, President of the *Tokyo Imperial University*, acted as Chairman. The second meeting will take place at Kyoto. (*Science*, Vol. LXIII, No. 1619, 1925).

Congresses and Conferences.

287. **Italy: International Conference on Emigration and Immigration. Rome, 15-31 May 1924.**

288. **XIIth International Congress of Agriculture, Warsaw, 21-24 June, 1925.** — Following on the information given in the last number of the Review regarding the resolutions passed at this Congress on Agricultural Instruction and Plant Production, and taking into consideration the fact that on the subject of phytopathological organisation and on epizootic diseases the conclusion which accompanied the separate reports (*v. Current Notices No.* 3, 1925, *of this Review*) have been accepted as final resolutions, hereunder follow the resolutions passed on Agricultural Experiments, Zootechnical Experiments and on Seed Testing.

Agricultural Experiments. — As numerous questions of a practical and theoretical character concerning varieties of improved plants, cannot be resolved except by collective experiments over long periods, the Congress invites the International Union of Growers of Selected Seed: *a*) to submit to the forthcoming Congress a draft of rules whereby it will be possible to compare and make use of the results of the experiments under discussion and those obtained in successive years in the various countries; *b*) to publish periodically in their own organ or in the *International Review of the Science and Practice of Agriculture* issued by the International Institute of Agriculture, Rome, all reports of general interest.

Given the importance of a rapid and economical solution of the numerous agricultural problems, the Congress invites the organs of the Agricultural Research Institutions of all countries to found an International Organisation having for its objects: *a*) the standardisation of methods of research; *b*) the supply to its members of all information regarding the research under study or in course of preparation; *c*) assignment to its members of specified research work; *d*) formation of a Drafting Committee which should publish all conclusions of general interest derived from the publications of different countries; *e*) the support of this International Organisation by the national Organisations already existing.

Lastly, for the study of soil science questions, the Congress is of the opinion that special international conferences should be held; and appoints, meanwhile, a Provisory Committee composed of Messrs. JELINEK (*president*), CASSADO DE LA FUENTE, DORPH-PETERSEN, JOURNÉE, KOSINSKY, ROY,

SISSESTI until such time as official members shall be appointed by the Governments or interested Institutions.

Zootechnical Experiments. — Given the necessity for zootechnical researches, the Congress has drawn the attention of Agriculturists to the advantages of: (1) the establishment of Zootechnical Research Institutes independent of Higher Agricultural or Veterinary Schools, having at their disposal land with stock of different breeds and varieties, and of an economic value; (2) the organisation of practical experiments, to be carried out under the direction of Zootechnical Research Institutes, on land belonging to the Agricultural and Veterinary Schools or Scientific Institutes, or even to private individuals who have the necessary staff and materials; (3) the consideration of the establishment of an International Institute of Zootechnical Research. For the realisation of this programme, the Congress has, meanwhile, appointed a Provisional Committee composed of Messrs. CASSADO DE LA FUENTE, ADAMETZ, ARENANDE, COSTANTINESCO, DECHAMBRE, EVART, MOCZARSKI, V. WENDT, until such time as official members shall be appointed by the Governments or interested Institutions.

Control of Seed Testing. — The Congress has made the following recommendations: (1) to give a permanent character to the technical control of the work executed by the Seed Testing Stations and to facilitate the training of the experts; (2) to publish every year a list of the Stations which have given results that may serve as a guide to international trade.

The Congress has further drawn the attention of public bodies of the various countries interested in the seed export trade, to the necessity of giving their support to the International Seed Testing Association and of giving the highest consideration to its proposals for the regulation of technical and commercial seed testing.

289. **Belgium: International Congress of Scientific Organisation of Labour. Brussels, 14-16 October 1925.** — On this Congress, held under the auspices of the Belgian Government, a considerable volume has already appeared comprising the reports presented at the Congress. The publication is divided in sections: General problems of organisation; Organisation of production; Determination of cost price; Sale organisation; Organisation of Offices; Application of the organisation to Administrative Public Services; Application of organisation to Agriculture. For further information on the Congress apply: *Secrétariat Général, Rue Montagne de l'Oratoire, 8, Bruxelles, Belgique.* (Congrès International de l'Organisation Scientifique du Travail, pp. 317, large 4, ill., diag. Brussels, 1925).

290. **East Africa: International Agricultural Conference. Nairobi, Kenya,** end of January 1926. — Invitations to this Conference which was arranged by the Government of Kenya were sent to the Governments of Tanganyika, Uganda, Sudan, Zanzibar, the Seychelles, Mauritius, Nyassaland, the Union of South Africa, Rhodesia, Mozambique, Belgian Congo, and Italian Somalia. The programme of work is in ten sections: Agricultural Production; Improvement of production; Experimental work in agriculture; Sale of produce; Classification of products; Agricultural Legislation; Stock breeding; Agricultural census and crop valuation; Agricultural instruction; Organisation of Agricultural Bureaus.

On the occasion of the Conference an agricultural show was held at Nakuro. It is hoped that further similar conferences will be held periodically, every three or five years, different colonies being chosen in turn for the meetings. So as to facilitate the work of preparation the head of the Agricultural Department or Bureau in the territory in which the meeting is to be held, will assume the office of president and his Government will provide for all the expenses of the visit of the various delegates.

291. **United States: IVth International Congress of Botanical Sciences. Ithaca, N. Y., 16-26 August 1926.** — This Congress will comprise Sections on: Agronomy (secretary: C. H. MYERS, Cornell University, Ithaca, N. Y.); Bacteriology (secretary: J. W. SHERMAN, Cornell University, Ithaca, N. Y.); Cytology (secretary: L. W. SHARP, Cornell University, Ithaca, N. Y.); Morphology, hystology and paleobotany: (secretary: D. S. JOHNSON, Johns Hopkins University, Baltimore); Ecology (secretary: H. L. SHANT, Bureau of Plant Industry, Washington, D. C.); Sylviculture (secretary: R. S. HOSMER, Cornell University, Ithaca, N. Y.); Genetics (secretary: C. E. ALLEN, University of Wisconsin, Madison, Wis.); Horticulture (secretary: A. J. HEINICKE, Cornell University, Ithaca, N. Y.); Physiology (secretary: O. F. CURTIS, Cornell University, Ithaca, N. Y.); Pathology (secretary: DONALD REDDICK, Cornell University, Ithaca, N. Y.); Botanical pharmaceutics (secretary: H. W. YOUNGKEN, Massachusetts, College of Pharmacy, Boston); Taxonomy (secretary: K. M. WIEGAND, Cornell University, Ithaca, N. Y.); Mycology (secretary: H. M. FITZPATRICK, Cornell University, Ithaca, N. Y.).

Although the Congress does not provide for a special Section to deal with special questions such as "rules for nomenclature", the Organising Committee has taken necessary measures in order that each section may be able to discuss similar arguments of international interest.

All communications and informations in regard to each section should be addressed to the secretary; those dealing with exhibitions and general to L. W. SHARP, Secretary Programme Committee of the International Congress of Plant Sciences, Stone Hall, Cornell University, N. Y.; those regarding excursions, collective trips, transportation, etc., to H. H. WHETZEL, (address as above), and those relating to the Congress in general to B. D. DUGGAR, Missouri, Botanical Gardens, St. Louis, Mo.

292. **United States: International Conference of Horticulture. New York City, 9-16 August 1926.** — It is being organised by the Horticultural Society of New York. The following subjects will be discussed: sterility of fruit in relation to seed production; fruitculture and seed production under the horticultural and agricultural aspects; botanical and general aspects of sterility and fertility.

293. **Pan-Pacific Scientific Congress. Tokyo, 27 October-9 November 1926.**

294. **First International Cold Congress. Rome, autumn 1927.**

295. **Pan-Pacific Medical Conferences.** — Dr. IGA MORI, delegate of the Pan-Pacific Union and executive secretary of the VI Meeting of the Far East Association of Tropical Medicine, held few months ago in Tokio, gave formal promise that the Association, on being invited to a Meeting to be held in India in 1927, would hold another meeting in 1929 in Honolulu,

Hawaii. Dr. G. B. COOPER, ex president of the Sanitary Office of the Hawaii Territory, and delegate of the Hawaii Government to the Tokio Conference, as well as special delegate of the Pan-Pacific Union, gave also assurance that after the India Conference 1927, the Union and the Association above mentioned would hold their meetings on Hawaiian territory.

296. **The IVth International Conference of Entomology, 1928** will probably be held in Honolulu, Hawaii. Preceding Conferences were held in Brussels (1909), Oxford (1912), Zurich (1925). That arranged for Vienna (1915) was not held. The Pan-Pacific Union has appointed a committee of entomologists, which will become permanent should the Conference be held in Honolulu.

297. **Proposal for a Conference to be held on Polynesian Races** has been made by Sir JOSEPH H. CARRUTHERS in the *Bulletin of the Pan-Pacific Union*, no. 72 (Honolulu, 1926).

298. **Spain: National Conference on Sericulture. Madrid, May 1926.** — Organised by the Council of National Economy, Ministry of Agriculture (*Fomento*) and Labour. Programme: (1) Cause of decadence of sericulture in Spain. Present situation. Necessity of rebuilding national silk industry. (2) General campaign for the progress of Spanish sericulture: *a*) distribution of knowledge on silkworm culture, *b*) installation of silkworm frames, *c*) planting of mulberry trees, *d*) utilisation of existing mulberry trees, *e*) rearing of the silkworm, *f*) installations for the suffocation of cocoons, *h*) national production of selected silkworm seeds, *i*) national production of chirurgical silk, *j*) advisability of furthering silk spinning in Spain. (3) Spanish legislation and national sericulture. Examination of the present legislation and improvement of seric activities. (4) Protection of the silk industry and revision of present legislative measures. (5) Creation of a Higher Central Body to co-ordinate and control legislative measures on sericulture.

299. **United States: Meeting of the American Association for the Advancement of Science. Kansas City, 28 December 1925 to 2 January 1926.** — A special number of *Science* (vol. LXIII, No. 1622, 1926) contains the report of this meeting drawn by the Permanent Secretary of the American Association for the Advancement on Science. As regards the agricultural sciences, the American Society for Horticultural Science presented eighty three communications and the American Phytopathological Society presented sixty three, including nineteen on diseases of cereals, ten on the pests of packing fruit, eleven on vegetable pests, six on virus diseases, nine on disease resistance and eight on miscellaneous subjects. Joint sessions were held of the American Phyto-Pathological Society and the Potato Association of America, also with the American Association of Economic Entomology. At the session of seed testing which was held by the official seed analysts a large part of the discussions was devoted to the methods of making germination tests and the genetics section was entirely occupied with the contribution of genetics to practical plant and animal breeding.

300. **United States: Fifth Congress of the International Union for Control of Tuberculosis. Washington, 30 September - 2 October 1926.**

301. **France : Congress on Stock Feeding, Paris, end of October 1925.** — This Congress was organised by the *Société nationale d'encouragement à l'agriculture*. General questions relating to stock feeding were handled by A. LEROY, chief of the Animal husbandry work at the *Institut agronomique*. He gave a short review of the publications on the subject which appeared in France. A number of reports were read on the new theories of feeding, on forage feeds for milch cows and butchers' beasts and on the silage of green forage. Nine monographs were also submitted by different directors of the agricultural services on feeding of milch cows as carried out in their respective departments.

302. **France : Congress of the Ligue générale pour l'aménagement et l'utilisation des eaux. Grenoble-Lyons, 16-22 July, 1925.** — The previous Congress of this League had been held at Lille in 1924. Among the reports made to the 1925 Congress which are of interest in connection with the subjects treated in this Review may be mentioned the following : — Eng. SAUVANET : Water requirements for rural populations ; — Eng. PRÉAUD : Syndicates of Communes for the supply of drinking water ; — Eng. DE PAMPELONNE : Water requirements for irrigation in the sout heastern region ; — Eng. EXPERT : Utilisation of water for agricultural purposes by means of evenly distributed irrigation. Other reports of an agricultural bearing were of a more or less local character. For information apply to the Headquarters of the League : 4, Carrefour de l'Odéon, Paris (6).

303. **France : French Congress on Birth Rate Problems. Clermont-Ferrand, 24-27 September, 1925.** — Five Sections : Legislation ; Economy and Vocational Policy ; Statistics and Propaganda ; Morals and Instruction ; Hygiene of the Dwelling House.

304. **Great Britain : Congress on the Production of Vegetable Oils, London.** — The usual annual Congress of the International Association of Seed Crushers took place in London in 1925 the Austrian and German delegates being present for the first time since the War. Italy was represented by Dr. BOLIS, Signor DI FAUSTO, Dr. MARANZANA, Dr. PALLAVICINO. As is well known the main object of these Congresses is to effect a gradual improvement, in accordance with the shippers, of the methods of International Commerce with oil seeds and oils. One of the characteristic features of this year's Congress was the tendency which was more and more evident to bring into consideration both the oil content, and the quality of the oil obtained from the various seeds as points to be submitted to arbitration. In this way it was resolved that an analysis of the content in oil in any arbitration relating to the quality of seeds must always be arranged for when requested by one of the arbitrators ; that enquiries should be made with a view to introducing into contracts for dry decorticated ground nuts a guarantee clause safeguarding the purchaser as to the maximum quantity of fatty acids : the question will be later carefully considered whether it is preferable for samples of the oil seeds to be preserved in milk or in glass.

305. **Italy : Congress on Agricultural Experiment, Rome, 19-20 March 1926.** — This Congress was held under the patronage of the Minister of National Economy, His Excellency BELLUZZO. Dr. G. Borghesani was

present in the capacity of Observer for the International Institute of Agriculture. Following communications were made: Prof. LUIGI SAVASTANO, Proposal for an official publication, "Reviews of Italian agricultural enquiries" (*Sunti degli studi agrari italiani*); Prof. NOVELLO NOVELLI, Problems of Rice cultivation; Prof. UGO BRIZI, Losses to agriculture produced by industrial establishments; Prof. GIROLAMO MOLON, The index of separation of the seeds in the table grape; Prof. GIOVANNI MARTELLI, Result of certain experiments in control of crop pests; Prof. FRANCESCO SCURTI, 1. Position of Fruit growing in Italy. 2. The problem of Fruit preservation; Prof. BARTOLO MAJMONE, 1. Co-ordination of the action of Agricultural Experiment Stations with that of the local agricultural lectureships in respect of the experiment and practical demonstrations. 2. Practical value of certain methods of stock feeding; Prof. GIOVANNI SANI, New ideas in manufacture of oils; Prof. ANTONIO MAROZZI, Agricultural experiment of the industrial and technical type; Prof. ANTONIO ZAPPI RECORDATI, Main problems of bee-keeping and the contribution of scientific experiments; Prof. CORRADO LUMIA, Some questions relating to Phosphatic fertilisers in connection with experiment; Prof. GIROLAMO AZZI, 1. Development on enquiries and research in the sphere of Agricultural Ecology. 2. Agricultural Ecology in relation to genetics as applied to agriculture Prof. GIOACCHINO DE ANGELIS D'OSSAT, Contribution to the study of agricultural land. Reports: Prof. VITTORIO PEGLION, Agricultural experiment and the measures of the Fascist Government; Prof. ANGELO MENOZZI, 1. Necessity for soil analysis. 2. Position of Research in regard to "stimulation" for plant development; Prof. NAZARENO STRAMPELLI, Reasons for and method of research into new varieties of wheat by means of hybridisation, adopted at the Royal Experiment Station for Wheat Growing at Rieti; Prof. FILIPPO SILVESTRI: 1. Modern methods of control of plant parasites. 2. Control of certain kinds of pests of the citrus fruits; Prof. OTTAVIO MUNERATI, Methods in experimental work; Prof. EMANUELE DE CILLIS, Report on the Experimental Institutes established for the "battaglia del grano" in Southern Italy and in the Islands; Prof. LIONELLO PETRI, Experimental work in plant pathology; Prof. GIACOMO ROSSI, 1. Need for collaboration for the scientific study of agricultural problems. 2. Preliminary notes on methods of bacteriological research in the examination of agricultural land; Prof. ALESSANDRO MARTELLI, On the direct use of ground phosphorites and leucites; Prof. GAETANO BRIGANTI, Problems of horticulture etc. in Southern Italy; Prof. GIUSEPPE TOMMASI, Activities and requirements of the agricultural stations.

306. **Italy: IInd Congress of the National Irrigation Federation. Bari, 14-16 April, 1926.** — The Congress discussed questions on agricultural credit, irrigation and land transformation. Amongst the places of interest visited by the Members of the Congress were: the Experimental Irrigation Fields belonging to the "*Acquedotto Pugliese*" at Foggia. For information apply to "*Sede Centrale della Federazione Nazionale delle irrigazioni*". Milano, 31, Via Monforte: Roma, 73, Piazza, SS. Apostoli.

307. **Italy: V National Congress of Labour Medicine. Genoa, 12-15 October 1926.**

308. **Italy : IInd National Congress of Pure and Applied Chemistry. Palermo, 23 May-2 June 1926.** — Coincides with the centenary celebrations of the birth of STANISLAO CANNIZZARO.

Exhibitions, Fairs, Competitions.

309. **Belgium : Centenary Exhibition, Brussels, 1930.**

310. **Belgium : International Exhibition. Brussels, 1928.**

311. **Italy : International Exhibition. Milan, 1928.**

312. **Poland: International Exhibition. Warsaw, 1928.**

313. **France : VIIth International Exhibition of rubber and other tropical products. Paris, 21 January-6 February 1927.** — Organised by the Committee of International Rubber Exhibitions, under the honorary Presidency of Lord COLWIN and of the ex director of the Imperial London Institute, Sir WYNDHEM DUNSTON, and the presidency of H. GREVILLE MONTGOMERY, will be held at the Grand Palais and will be the First International Exhibition of tropical and sub-tropical agriculture. Adherence has been received from : the Rubber Growers' Association ; Governments of Ceylon, of the Malay States, the Dutch Indies, the Gold Coast, Nigeria, Belgian Congo, Brazil, Columbia, etc. The Exhibition is under the auspices of the French Ministry of Colonies, Foreign Affairs, Commerce and Industry, and the Under-Secretary for technical instruction.

During the Exhibition, under the presidency of Prof. EM. PERROT Pharmaceutical Chair, Paris, and Sir WYNDHEM DUNSTAN, International Conferences on tropical agriculture will be held, following the lines traced at the preceding Exhibitions in London and Brussels. An International Congress for the scientific and technical study of the various branches of tropical agriculture is under project. For information apply to the *Administration of International Exhibitions*, 43, *Essex Street Strand, London, W. C.* 2.

314. **France : LIIIrd International Exhibition of Aviculture. Paris, 10-15 February 1926.** — Organised by the *Société Centrale d'Aviculture de France* at the Exhibition Park of the City of Paris (Gates of Versailles).

315. **Austria : International Fair. Vienna, 7-13 March 1926.**

316, **Italy: International Building Exhibition. Turin, May-June 1926.**

317. **Italy: International Competition in machinery for transplanting rice and other cereals. Vercelli, April-June 1926.** — This Competition has been set by the Royal Experiment Station of Rice culture of Vercelli, under the auspices of the Ministry of National Economy and of the Experimental Institute of Agricultural Mechanics. Preference was given not only to machines executing the operations of transplanting as much as possible by automatic means, but also to machines which could be used for the transplanting of other cereals, specially wheat. Experiments were to be of two kinds : preliminary (working of the machines when still on dry ground, etc., taking apart of the machines, resistance of the various parts and working resistance) on rice fields of the Vercelli province, on grounds of medium grade of dampness employing plants of the " Original Chinese "

variety or similar varieties, with normal development (40-50 days after sowing) and even on grounds of different degrees of dampness or with other variety of rice or with plants with different grades of dvelopment. To these were to follow laboratory experiments to control the functioning of the machines under the most varied conditions, and trials on other plots, of machines to be used also for the transplanting of other cereals.

318. **Italy: International Competition of Viticultural Machinery, Barletta.** — This Competition is set by the *Cantina Sperimentale* of Barletta and deals with: A) Mechanical appliances, either by direct traction or funicular suitable to the execution of: (1) deep ground work for the planting of vineyards; (2) work of medium depth or superficial for ditches; B) special ploughs, harrows, and cultivators either by mechanical or animal traction; C) appliances for the spraying of insecticide and fungicide substances either by mechanical or animal traction. For particulars: *Director of the Cantina Sperimentale, Barletta, Italy.*

319. **Italy: International Sample Fair, Padua, 5-20 June, 1926.**

320. **France: International and Colonial Sample Fair, Bordeaux, June, 1926.**

321. **United States: World Fair, Philadelphia, 14 June-1September 1926.**

322. **Germany: Agricultural Fair, Cologne, July 1926.**

323. **Italy: International Exhibition Fair, Fiume, 1-30 August 1926.**

324. **Danzig: Fourth International Exhibition, August 1926.**

325. **Italy: Fifth International Roadmaking Exhibition, Milan, September 1926.**

326. **Switzerland: Ninth International Agricultural Exhibition, Geneva, September 1926.**

327. **Germany: Dog Show, Berlin, 22-23 February 1926.** — The German Shepherds' Dog Union (*Deutscher Schäferhund-Verband*) organised this exhibition which was planned to include a number of breeds of ordinary dogs as well as breeds specialised for various kinds of uses, life-saving breeds, large watch-dogs, messenger dogs, etc. A number of exhibits of various breeds were made by the *Berliner Hunde-Renn-Club*.

For information apply to: *Deutscher Schäferhund-Verband, Sekretariat: Berlin-Wilmersdorf, Zähringer Strasse,* 26.

328. **Germany: Photographs illustrative of Scientific Stock Breeding shown at the XXIth Travelling Exhibition of the German Agricultural Society. Stuttgart, 18-25 June 1925.** — At this exhibition to which reference has already been made in an earlier number of this Review (October-December 1925), the *Deutsche Landwirtschafts-Gesellschaft* resumed the zootechnical photographic exhibits. Before the war the Prussian Ministry for Agriculture, State Lands and Forests offered as prizes for agricultural and stock-breeding exhibits from the different States of Germany the photographs and phototypes of this Exhibition. These are accurate reproductions showing the progress which is being made in Germany in the breeding of animals of value to agriculture. The reproductions also are well adapted for instructional purposes. To every photograph is at-

tached a note of the species of the animal, breed, ancestry, measurements, weight, etc. For information apply: *Deutsche LandwirtschaftsGesellschaft, Berlin S. W. 11, Dessauer Strasse 14.* Orders also taken.

329. **Germany: XVIth General Exhibition of Aviculture. Dresden, 15-17 January 1926.**

330. **Germany: Agricultural Week. Halle on Saale, 19-22 January 1926.**

331. **Germany: Bavarian Agricultural Week. Munich, 25-27 January 1926.**

332. **Germany: Saxon Agricultural Week. Dresden, 25-29 January 1926.**

333. **Germany: Exhibition of Poultry and Rabbit Breeding. Greifenberg, 14-16 February 1926.**

334. **Germany: Technical Exhibition of Lighting, Heating and Cold. Königsberg, 14-21 February 1926.**

335. **Germany: Great Tobacco Fair. Berlin, March 1926.**

336. **Germany: Colonial Fair. Berlin, 14-16 April 1926.**

337. **Germany: Fair and Exhibition of Hygiene, Berlin, late April.**

338. **Germany: Horticultural Exhibition. Dresden, May-September 1926.**

339. **Germany: Great Sanitary Exhibition. Düsseldorf, May-October 1926.**

340. **Germany: Slaughter Stock. Exhibition Berlin, 11-13 May 1926.**

341. **Germany: Agricultural Exhibition. Lubeck, 15-16 May 1926.**

342. **Spain: Vth National Competition of Animal Husbandry, Aviculture, Agricultural Machinery and material for rural instruction. Madrid, 14-23 May 1926.** — Organised by the General Association of Stock Breeders of Spain.

343. **France: LIInd Avicultural Competition. Paris, 7-11 November 1926.** — Organised by the *Société Centrale d'Aviculture de France* at the *Jardin d'Acclimatation.*

344. **Algeria: Wheat Competition and Exhibition. Algiers, October 1925.** — Organised by the Chamber of Agriculture of Algiers, Oran and Costantine. For particulars: *M. le Commissaire Général de l'Exposition de blés. Institut Agricole d'Algérie.*

345. **Tunis: Exhibition of Hygiene. Tunis, 2-5 April 1926.** — Held on the occasion of a Medical Congress.

346. **Ireland: Agricultural Exhibition. Dublin, Spring 1926.**

347. **Italy: National Chrysanthemum Show. Trent, November 1925.**

348. **Italy: Zootechnical Competition at the Milan Fair. April 1926.** — Show of milking and reproduction stock: 12-14 April; Livestock show (international competition of fattened livestock): 16-18 April; show of pigs, sheep and goats: 12-18 April; Dog show, poultry, pigeon and rabbit show: 20-22 April; Horse show, forming part of the International Competition organised by the "*Società Italiana del Cavallo Belga*", and the Shoeing Competition: 23-25 April. On 17-18 April Field trials were held for Conti-

nental Dogs, registered at the K. C. J. and L I. R.; on 26-27 Military Horse Races were run.

349. **Italy: Sicilian plough Competition. Caltanissetta.** — Under the auspices of the Ministry of National Economy and the Permanent Wheat Committee, this Competition was set by the Caltanisetta Chamber of Commerce and Industry, together with the Provincial Commission for Wheat Propaganda and other Public Bodies of that region, for "a plough or machine answering to the peculiar condition of the soil, climate and traction means existing on most landed properties in Sicily". This competition (entries closed on 31 May) is being held on the occasion of the First Regional Wheatculture Show which will open in September 1926. There will be three prizes each for L. 35.000, L. 20.000, and L. 10.000 and small prizes for competitors presenting a system of harness which will utilise, in the best possible way, the efforts of the horses for the traction of the plough or the equivalent machine. For particulars: *Executive Committee for the Competition c/o the Chamber of Commerce, Caltanissetta.*

350. **Bessarabia: Exhibition and Sample Fair. Chisinau.** — The State agricultural and viticultural institutions exhibited a vast scientific material. The National School of Viticulture of Chisinau, the Administration of Crown properties, the Roumanian agricultural, horticultural, forestry, piscicultural institntes, etc., were well represented. The Union of Wheat Growers of Czeco-Slovakia has exhibited a collection of selected wheats. Firms from Poland and Czeco-Slovakia contributed largely to make the products of their industries well known. France also had considerable exhibits.

351. **Japan: IInd Exhibition of Chemical Industries. Tokio, 19 March-17 May 1926.**

352. **Russia: Exhibition of Technical Innovations. Moscow, 15 February-15 April 1926.**

353. **Georgia: Agricultural Exhibition. Tiflis, 15 April-1 June 1926.**

354. **Switzerland: Exhibition and Slaughter stock Competition. Langenthal, 29-30 March 1926.**

Development of Agriculture in the different Countries.

355. **Brazil: Cotton Growing in the State of Sergipe.** — The President of the State of Sergipe, with a decree dated 8th February 1923, founded the Cotton State Department, leaving the Experimental Cotton Station "*Miguel Calmon*" under the direction of Prof. TH. R. DAY, a well known North-american specialist. Thus were created the Experimental Stations of "José Bezerra" in Dores, "Simões Lopez" in Propriá, "Pereira Lima" in Estancia, "Candido Rodrigues" in São Paulo de Sergipe.

On the 20th August 1923 the above Department called the first Meeting of Cotton Growers to discuss the most important questions. From this Meeting the Department collected precious data for the regulation of the cotton industry, and the State Government issued the law of 21 September 1923. In the following year the first Cotton Fair was organised in Aracajù (25 Feb-

ruary). In 1924 all the work done by the Experiment Stations was damaged by heavy rains, which beside flooding the cultivations, paralysed the traffic and hindered the efforts of the Department. This notwithstanding, the results were satisfactory and the selectioned seeds obtained were above the necessities of the State of Sergipe. First quality cotton was exported to South Brazil. Seeds of the "Day's Pedigree" variety were supplied to the State Growers and to the Governments of Santa Catharina and Bahia. (*Mensagem apresentada á Assemblea legislativa em 7 de Setembro de 1925 pelo Dr.* MAURICIO CARDOSO, *Presidente do Estado de Sergipe*).

356. **Brazil: Cultivation of Lucern (Alfalfa) in the State of São Paulo.** — Lucern has always been largely cultivated in the country of Chavantes in the State of São Paulo. In many regions of this State it is grown on all farms for grazing purposes and it proves to be an excellent feed producing fine live stock. (*Dr.* ROGERIO DE CAMARGO, *A Cultura de Alfalfa en São Paulo. Ceres, Revista de Agricultura,* São Paulo, Setembro 1925).

357. **Brazil: Production of Tobacco.** — The State of Bahia produces 90 % of Brazilian tobacco. The crop for the season 1924-25 amounted to 34,650,000 kilogrammes, while a production of 48 millions and a half was expected. Brazil tobacco goes all over the world, except to the United States and to England. There are no large tobacco plantations, as cultivation by the modern systems would be very costly. Nor is the soil manured and if the tobacco is of good quality it is due to the climate. The varieties imported from Sumatra and Cuba have not given any important results. Harvest is begun in July or August and goes on for five or six months. Every 1000 plants produce 150 kilogrammes of leaves. The plants are attacked more by insects than by cryptogams; among the insect pests are the larva of *Protoparce paphus* which eats the leaves. The manufactured product is attacked by the coleopteron *Lasioderma serricorne* and by the washerwoman ant. (*O Agricultor*. Publication of the School of Agriculture of Lauras, Minas Geraes, Year IV, No. 4, 1925).

358. **Brazil: The Rubber Problem.** — The immense forests of 'Hevea' which are one of the principal natural resources of Brazil, especially in the Amazon province, and which would, constitute a very large source of income to the Confederation, cannot be properly worked from a number of circumstances, including want of transport facilities, absence of a protection policy, etc. all of which the Government is now anxious to remove. The Department for Inspection and Encouragement of Agriculture is meanwhile issuing instructions to its inspectors in the Acre Territory, and in the States of the Amazon, the Pará, Maranhão, Piauhy, Bahia and Espirito Santo, with a view to their undertaking an intensive propaganda for the creation of new plantations, the distribution of seeds and the organisation of experiment and demonstration plots. It would appear however that the problem of Brazilian rubber lies in its home utilisation as a raw material, while waiting to secure its proper position on the world market. The national manufacture of rubber goods ought at the present time to absorb the production of the Amazon basin. (*La Gazette du Brésil*, No. 199. Paris, 1925).

359. **Brazil: Sylviculture.** — The writer DE ALMEIDA TORRES,of the Amazon province, in an article entitled " Breves notas para o Estudio Florestal do Brazil " (Publication of the Brazil Federal Ministry of Agriculture Industry and Commerce) treats the subject from the descriptive point of view. He prefaces the work by some historical notes on the study of Brazilian forests, beginning from the era of Portuguese colonisation, which he obtained from an interesting official document, dated 1809, giving full detail, which is preserved in the 'Museo Paulista' of São Paulo.

The forest classification of the lands has not yet been properly studied in Brazil, although the Federal 'Instituto de Chimica e do Serviço Geologico Mineralogico do Ministerio da Agricoltura' by its original research work makes provision for the study. The distribution of the Forests is as follows: A. Forests of the Equatorial Zone which reach their maximum development in the 'Hylaea' of the Amazon region and cover some three million square kilometres. In the State of Pará alone there are reckoned, according to Dr. HUBER, to be 400 kinds of timber of which the most suitable for building are: " louros, canellas, acapú, pau roxo, sucupira, pau amarello, andiroba, massaranduba, tarumá, etc.

B. Forests of the Atlantic coast, from the Cape of S. Roque to the State of Rio Grande do Sul, where the best known timbers are the following: guarabú, canellas, cedros, perolas, pinheiros, jacarandás, vinhaticos, aloés, Gonçalo Alves, etc.

C. The forests of the interior, where there is an abundant rainfall, are divided according to altitude into the forests of cerradão, caatanduvas and faxinaes, and the principal building timbers are perobas, jequitibás, aroeiras, cedros, massanduba, etc.

D. The forests of the river banks, which as it were follow the variations in the course of the streams, and form the vegetation of the greater part of the central area of Brazil.

The building timbers found in these forests are ' aroeiras, pau de jangada, cedros angelins, louros, etc.

3. The forests known as 'capões', less extensive than the last type, mainly produce the timbers " cedros, cabreuvas, canellas, açeita cavallo, etc. ".

The nomenclature and the classification of the forest species of Brazil are to be found throughout the works of MARTIUS, EICHLER, FREIRE ALLEMÃO, ALEXANDER HUMBOLDT, HUBER, GLAZIOU, LOEFRGREN, DUCKE, BARBOSA RODRIGUES, etc. In the last few years the Belgian-Brazilian Biological Mission has also been publishing leading works on forest ecology, among them those of Prof. J. MASSARI of Brussels. At the present time there is an idea of founding biological stations for studies in acclimatisation, development and production of plants in relation to ecological factors.

The portion of the work of ALMEIDA DA TORRES which deals with forest economy is rich in statistical data.

Alagôas: 265,774 hectares of forests. The most remarkable of the products is the 'côco'. The school '*Aprendizado Agricola*' has been established in the town of Saturba at the expense of the Federal Government.

Amazonas : 6,273,554 hectares of forests. Rubber is the chief forest industry. The agricultural movement began in this State in 1916 with the foundation of the '*Club da Seringueira*'. A 'Horto florestal' has been formed recently.

Bahia : 1,761,353 hectares of forest. The Federal Government maintains in the State the "Aprendizado agricola da Joazeiro", and a similar training school called 'Francisco', and makes a grant towards the 'Escola agricola de Bahia' founded by the State Government. The 'Horto florestal' of the town of Joazeiro covers an area of 62 hectares and was instituted mainly for the purpose of establishing woods along the canals which the local government had had dug to the north-east of the State.

Ceará : 1,327,994 hectares of forest. The Federal Government makes grants towards the 'Escola de Agricultura Practica de Quixada' and the 'Escola Agronomica de Fortaleza', in both of which sylviculture can be studied. The 'Horto florestal' de Quiada, founded in 1911 in the locality of Cedro covers an area of 48 hectares, including 23 hectares of *Eucalyptus, Casuarina, Morus* and *Phoenix dactylifera*, and besides maintains an agricultural school.

Federal Area : 0,200 hectares of forest. The 'Secção Horto florestal do Jardim botanico' of Rio de Janeiro, established in December 1911, had distributed up to 1924 nearly 9,204,925 seedlings of Eucalyptus of different kinds and other forest species. There are also in this district a number of woods composed of native and exotic species.

Espirito Santo : 639,779 hectares of forest. In 1921 the State Government appropriated the estates of the 'Société Forestière' consisting of 2,400 square kilometres of primaeval forest with an immense number of species. The law of 23 December 1921 authorised the State Government to place contracts for the investigation of the forest resources of the State.

Goyaz : 5,286,336 hectares of forest. The Federal Government makes a grant to the 'Escola Pratica de Agricultura de Jatahy' which is to give general instruction in forestry.

Maranhão : 1,024,696 hectares of forest. In the region of the river Parnahyba the *Orbignya speciosa* Barb. Rodr. (Babassú) is very abundant and forms one of the chief products of the State. In the valley of the river Gurupy there are forests of *Copernicia cerifera* Mart., which produces the Carnauba wax. The Federal Government makes a grant to the 'Christino Cruz Aprendizado Agricola' of the town of S. Luiz.

Matto Grosso : 3,032,964 hectares of forest. The *Hevea brasiliensis* Mull. Arg., which is rubber producing, grows abundantly in the forests of the boundary zone between the Amazon and the Pará provinces. The *Ilex paraguayensis* St. Hil. (the maté) grows in the South of the State.

Minas Geraes : 14,349,920 hectares of forest. Within the last few years the forest gardens of Bello Horizonte, Nova Baden, and Cataguazes have been made : the first of these distributed during the period 1921-24 nearly 1,458,154 seedlings of *Eucalyptus* and of other species. It may be remarked that more than two million plants of *Eucalyptus* have been planted on six farms alone.

Pará : 5,873,109 hectares of forest. The chief industry is the extrac-

tion of rubber from the *Hevea brasiliensis*. The forests of *Bertholletia excelsa* H. B. and K. are mainly found on the banks of the river Tocantina and near the Guianas.

Parahyba: 442,744 hectares of forest. The 'Horto florestal' of Parahyba is maintained by the State Governement.

Paraná: 2,448,133 hectares of forest. The law of April 1907 set up a State Forestry Code. The principal forest species are the *Ilex paraguayensis* St. Hil. and the most important timber is the *Araucaria brasiliensis* Lamb. The 'Escola Agronomica do Estado' is an important institution for local work.

Pernambuco: 721,978 hectares of forest. The State possesses the following institutions: 'Escola de Agronomia' and the agricultural schools of Goiana and of the Benedictine Order which receive grants from the Federal Government: there is also the Course in agricultural science at the School of Engineering.

Piauhy: 6,333,637 hectares. The principal species are *Copernicia cerifera* Mart., which yields the Carnauba wax, and the babassú (*Orbignya speciosa* R. Br.). In the town of Therezina there is the 'Escola Practica de Agricultura' and in Corrente there is the 'Instituto Agricola Industrial' which is in receipt of grants from the Federal Government.

Rio de Janeiro: 1.069,872 hectares of forest. The area of the ancient forests of the littoral is now much reduced. The Botanic Garden which is maintained by the Government is in Nichteroy.

Rio Grande do Norte: 440,481 hectares of forest. One of the principal products is the Carnauba wax. The 'Campo de Demonstração' which receives grants from the Federal Government is in Macahyba.

Rio Grande do Sul: 440,213 hectares of forest. The forestry service which is arranged by the 'Directoria de Terras' divides the forests of the Northern zone into nine sections placing them under the care of forest rangers. The 'Escola de Agronomia de Pelotas' and the other school of the Municipio do Rio Grande are maintained by the local government authorities.

Santa Catharina: 1,670,063 hectares of forest. The main timber products are obtained from the *Ilex paraguayensis*. The fellings are not regulated by law. The 'Campos de Demonstração' of São Pedro de Alcantara and of Tubarão and the 'Instituto Polytechnico' are able to provide instruction in forestry.

São Paulo: 5,167,606 hectares of forest. There is a Serviço Florestal with a 'Horto e Reserva Florestals' situated in the Cantareira Pass, a well organised institution which during the period 1919-1922 distributed 5,738,132 seedling forest plants of different species. Valuable assistance has been given by private initiative to the State Government, the 'Hortos Florestaes' of the 'Companhia Paulista' situated in Jundiahy, Bôa Vista, Rio Claro and in other places having contributed to the peopling of the forest in many localities by distribution of some 20 million plants of *Eucalyptus*. Instruction in sylviculture is given by the 'Escola Agricola Luiz Queiroz' and by the 'Escola Polytechnica do Estado'. In 1911 the forestry service was instituted and the law of December 1917 authorised the "Secretaria da Agricultura" to improve the 'Horto Florestal' already mentioned using the funds of the 'Serviço Florestal' of the State.

Sergipe: 122,290 hectares of forest. The law of November 1913 established the Code of the Forest Service: and the regulations relating to this Code were made in April 1914.

Territorio do Acre: 2,785,333 hectares of forest. Chief products timber and rubber.

This important study made by DE ALMEIDA TORRES concludes with a list of all the short titles of the forestry legislative provisions, whether federal or State. A bibliographical chapter is added containing 91 headings.

360. **Chile: Agricultural Production.** — Dr. HANS ANDERSON, in a monograph published in a special part of the *Tropenpflanzer*, deals with the bases and the present day conditions of Chilean agriculture. Among the factors contributing to these conditions he passes in review that of the relief and hydrographical configuration of the country, the climate, the natural production, irrigation, ownership in land and fertilising. He examines separately and in detail the diffusion and the yield of the various crops of the region, cereals, leguminous or textile plants, rice, tobacco, cane sugar and sugar beet, the production of the various breeds of cattle and livestock, and finally in a few paragraphs he sums up his observations on the factors of a potential increase of yield from the agriculture of Chile and in particular: the more intensive cultivation of areas already cultivated; increase of head of cattle on the pastures; the irrigation of areas not yet utilised though suitable for agriculture; increase in the cultivable lands by the clearing of forest areas; improvement in transport conditions.

From the geographical point of view of agricultural production, Chile possesses vast regions which are suitable for cultivation and yet remain uncultivated on account of shortage of labour. In 1918, with an area of 750,572 square kilometres, the density of the population was reckoned to be only 5.3 to the square kilometre. The author notes that Chilean agricultural and livestock production has found its way and still finds it with profit on to the world markets, and while the export of nitrate has met with a competition which it is impossible to ignore in the increasing production of synthetic nitrogenous fertilisers, the State of Chile has before it a work of high importance in the settlement and colonisation of its arable land.

(H. ANDERSON, Die natürlichen Grundlagen und die gegenwärtigen Verhältnisse der Landwirtschaftlichen Produktion in Chile. *Beiheft zum "Tropenpflanzer"*, vol. XXII, No. 2, 145 pp., small 8 vo., 3 maps. Berlin, 1925).

361. **United States: Tobacco Growing in the Connecticut Valley.** — The Connecticut Agricultural College together with the Connecticut Valley Tobacco Growers Association has undertaken the agronomic study of this region in order to start and develop tobacco growing. (*Science*, No. LXII, No. 1617, 1925).

362. **Italy: Development of Sugar Beet Cultivation.** — In the Bulletin of Italian Sugar Industry (*Bollettino dell'Industria Saccarifera Italiana*, 1 January 1926), Dr. G. MORI points out the progress achieved by other nations in the production of sugar beet, and the measures and practice that should be adopted in Italy to improve the cultivation of this plant. He refers to the excellent and practical working programme elaborated by the

Agricultural Chair of Ravenna consisting in the diffusion of cultural technique, in the institution of practical demonstration fields to which national technical knowledge can be applied, and in setting Prize Competitions amongst the Beet growers.

363. **Tripolitania : Distribution of Electric Power for Agricultural Purposes.** — The "*Società elettrica coloniale di Tripoli*" which has built a large Central Power Station will be able to extend the distribution of electric power to the oasis of Tripoli, Gargaresc, Gurgi, Such el Giuma and Tagiura as well as to the nearest crownlands within the zone of concession. (*La Corporazione dell'Agricoltura*, year I, No. 2. Rome, 1925).

364. **Poland : Agriculture in Poznan.** — The following date are taken from a publication by the Agricultural Chamber of the Poznan Palatinate, on the occasion of the XIIth International Congress of Agriculture held at Warsaw in 1925. In the Poznan Palatinate — which covers an area of 26,603 km² — the ground suitable for cultivation represents a good 90 % of the total ara and contains 173.422 economic-agricultural units. These units are spread over 2,366,936 ha., of which 49,5 % is represented by the medium and large rural property. Complessively, the ground suitable to cultivation, the gardens and orchards amount to 65.7 % of the entire area of the Palatinate ; meadows to 7.7 % ; grazing grounds to 2.2 % ; forests to 18.1 %. The area of large properties is sub-divided in : Crown lands (294,400 ha.), ecclesiastic properties (30,700 ha.), various public properties (4,700 ha.), private properties (1,083,800 ha.).

From the technical point of view, the development of agriculture has as index the use of chemical fertilisers which, annually, amounts to 882,000 q. of potash, 1,132,000 q. of azote and to 3,701,000 of phosphates.

The crop figures per unit are very high as compared to other Polish regions and even to Germany. Amongst the cereals, first place is given to rye, followed, according to statistics, by wheat, barley, oats, and weeds. Each km.² carries 210 fruit trees. The organisation for the production of selected seeds is completely up to date. In the economic life of Poland a prominent place is occupied by the agricultural industries of Poznan, principally the sugar industry, whose interests are represented by the "Union of Sugar Factories in Western Poland and by its organ" "*La Banque Sucrière*". Distilleries are organized in "The Union of Distilleries of Western Poland".

Live stock production is well developed in Poznan. The type of horse bred resembles the East Russian. The race is much improved by using government stallions, and efforts are bring made to breed a special military horse. As regards cattle, beside the black and white spotted type, there is, especially in South Poznan, a native breed, of uniform reddish coat, very strong, and most suitable for hard work. The black and white spotted type, which before the war was bred for slaughter is at present bred for milking, and consequently, a great number of breeders have now formed a Society for the Control of milk production. Pig breeding is well developed, two types being known, the native and the Yorkshire, whilst sheep breeding is not very diffused owing to the small profits there would derive. All live stock owners are organised in associations according to their respective branches.

The organisation of agricultural instruction is good. There is a faculty of agriculture and sylviculture at Poznan, a secondary agricultural school at Dojanovo, and numerous winter schools subsidised by the Agricultural Chamber, where classes are held from the beginning of November to the end of March. In summer the pupils attend a practical course. There are also schools of domestic economy, horticulture, dairy and cheese making, etc.

Agriculturers, organised either in public or private companies, are officially represented at the Agricultural Chamber, whose existence is guaranteed by the contribution payable by all agriculturists, who have the right to appoint the Board of Directors of the Agricultural Chamber.

Miscellaneous.

365. **Brazil : Mechanical Coffee picking machine.** — Dr. ANTONIO DE BARROS UCHOA has invented at Riberão Preto, Brazil, a coffee picking machine, on the aspirating system, which will allow a considerable decrease in the number of hands employed on Coffee plantations. This machine called "*Guanabara*" can be introduced between the rows without damaging the plants given its width measurements (m. 1,10-1,20) and small speed. It is horse drawn and worked by a Ford motor and requires three persons to handle it. It picks and cleans 120 litres of coffee per minute using 36 litres of gazoline for every ten working hours. The machine in question has been recommended by several Brazilian experts amongst which are Dr. MUCIO WHITAKER and Dr. JORGE LOBATO MARCONDES MACHADO, of the *Sociedade Paulista de Agricultura* (*Gazetta da Bolsa*, Year IX, No. 7, Rio de Janeiro, 1926).

366. **Brazil: Resources and possibilities for the manufacture of mineral fertilisers in Brazil.** — Amongst the natural silica there are orthoclase and leucite, rich in potash, which can be utilised as they abound in Brazil in the Tinguá Mountains, Santa Cruz, Cabo Fris, Itatiaya, in the districts of Poços de Caldas, in the Atlantic islands of Fernando de Noronha and Trinidade. 438 kg. of leucite pure (which corresponds to 490 kg. of leucite at 90 % of potash) mixed with 504 kg. of nitric acid and with 448 kg. of chloride of potash, supplies 810 kg. of saltpetre. Another source of material rich in potash is found in the manufacture of cement; from one ton of this it is possible to obtain, as residual, 25 kg. of potash; that is, an annual production, in a small factory, of 1000 tons of pure potash, or 3000 tons of potash fertiliser.

Phosphatic fertiliser is obtained from apatite, which is plentiful in the State of Minas Geraes near Cidade de Salinas, where the metamorphosis of the rocks of gneiss takes place. Apatite contains from 39 to 42 % of phosphoric acid. In other parts of Brazil kraurite and dufrenite are utilised, which contain 28 % of phosphoric acid. Another source of phosphoric acid is given by the monazitic sands which are formed by the erosive action of sea waves on the granite rocks of the Brazilian coasts of Praia di Massambaba, Cabo Frio, Macahè in the State of Rio de Janeiro, of Giry, Guarapary, Kova Almeida, Regencia, S. Matheus, in the State of Spirito Santo, and further of Prado, Cahy, Carahyba, in the State of Bahia.

The fusion of monazite with soda or with caustic potash, at a temperature of 500°-550° C produces phosphates of soda or potash, which can be transformed in calcium phosphate and used as fertiliser. (Dr. FEDERICO W. FRIESE. Nossos recursos e possibilidades para o fabrïco de adubos mineraes. *Revista da Sociedad Rural Brasileira*. São Paulo, 1925).

367. **Brazil: The use of eucalyptus for the production of printing Paper.** — Experiments made by the *American Forest Products Laboratory*, with eucalyptus timber of the State of São Paulo (Brazil) for the production of printing paper have given excellent results. Dr. E. NAVARRO DE ANDRADE, who was present at the experiments made in Madison, is of the opinion that paper manufacture in Brazil will have a vast development, as with the timber in question it will be possible to place on the Brazilian market a product, at half the price of the imported product.

The same species of eucalyptus used in these experiments grows in California, New Mexico, Arizona and Florida where the climate is suited to a rapid development of the tree and to the supply of cellulose pulp in less then ten years. (*Industrial and Engineering Chemistry*, Vol. 4, No. 1, New York, 1925).

368. **Brazil: Climate in the State of Rio Grande do Sul.** — PAWELS, for his study on the argument, has taken all data from the Annual Bulletins of the Meteorological Service of the State of Rio Grande do Sul, as observations from other sources were not reliable. A large number of Stations completed in 1922 a decennial period of observation. There are 39 meteorological Stations in the State; making an average of one station for every 7,300 km²; in the above bulletins they are subdivided in five regions: Littoral, Central Depression, Country, Valley of Uruguay, Serra. (P. G. J. PAWELS. Subsidios para una climatologia do Rio Grande do Sul. *Egatea, Revista da Escola de Engenharia de Porto Alegre*. Vol. IX, Nos. 3, 4, 5, 6, 1924; Vol. X; Nos. 1, 2, 3, 4, 5, 1925).

369. **Spain: Artificial and natural silk.** — Artificial silk production in America is calculated at about 50 million pounds, in Italy at about 28 million lbs. and in Spain at about 300,000 lbs. GONZÁLEZ MARÍN's article shows the apprehensions regarding the future of the real silk industry to be without foundation. The lower cost of artificial silk — to which a hardly suitable denomination has been given —, does not compensate for defects in appearance, in lasting qualities, etc., advantages to be found in the natural silk.

Contrary to general belief, the continuous development of the silk industry has not the effect of decreasing the price of raw cocoons, and no fears need be entertained as regards the future of this industry, given the ever increasing consumption of natural silk, as is clearly shown by the fact that no one year's production of silk can be kept in stock for successive years.

In Spain great efforts are being made to build up once again the former world renowned silk industry. Although Spanish production is insufficient for national requirements, silk is being exported in the raw state, which proves the importance given to the product itself. The author is of opinion that the creation of a national Spanish market would be advantageous, as obviating the necessity for relying on foreign markets.

The author concludes by enumerating the advantages of sericulture. The Spanish Government is taking the necessary steps for the diffusion of technical knowledge of this industry. (GONZÁLEZ MARÍN F. El extracto de celulosa y la seda natural. *El Progreso Agricola y Pecuario*, Year XXXI, No. 1401. Madrid, 1925).

370. **American Bibliography of the Natural Sciences.** — Some years ago the *American Library Association* undertook to publish a list of the hundred best works on Natural Sciences and to ensure accuracy invited the Academy of Sciences of Washington to co-operate and a special Revising Committee was appointed. Some few months ago a second edition of this list was published containing a short summary of each volume. Paragraphs deal with each group so as to give the reader a clear idea of science as a whole and its branches. The hundred works are grouped under the following titles: Works of general character; sciences of man; sciences of life; soil science; sciences of the skies; sciences of things and phenomenons; sciences of forms and relations; history of science. (*Revue générale des Sciences pures et appliquées*, Year 36, No. 22. Paris, 1925).

371. **Estimation of productive qualities of ponds.** — Mr. DE BROUIN DE BOUVILLE, Chief Inspector of Waters and Forests in France and French Delegate at the XIIth International Congress of Agriculture held at Warsaw, sums up his critical study on the estimation of the productive qualities of ponds, in the following conclusions, which were adopted by the Congress:

In the various countries where carpiculture is practised, uniform rules should be adopted for the determination of the biological, chemical and thermic state of the ponds, in order to define their productive qualities or possibilities, on which is based their scientific yield.

Agreed methods should be used for obtaining comparable results regarding the estimation of the available fish feeding material by the introduction of plancton (*synthetic index*) and organic substances (*chemical index*); and for reckoning the period of utilisation of the material or in other words of the period of development of the carp, the physiological activity of which depends entirely on the temperature (*thermic index*). (*Revue générale des Sciences pures et appliquées*, Year 36, No. 20. Paris, 1925.

372. **France: Centenary of Chevreul's Discoveries on Fats.** — On the occasion of the Fifth Congress of Industrial Chemistry, held in Paris last October the *Société de Chimie industrielle* with the collaboration of the *Muséum d'Histoire naturelle* and of the *Société chimique de France*, commemorated this centenary in the same theatre in which CHEVREUL accomplished the greater part of his work. Among the speeches delivered on that occasion, that of Prof. L. MANGIN, director of the Museum, Member of the Institute and President of the Confederation of Scientific Societies in France, was reported *verbatim* in the *Revue générale des Sciences pures et appliquées*, Year 36, No. 22, 1925.

373. **Animal Traction through the Centuries.** — The commandant LEFEBVRE DES NOETTES has published through the firm of Berger Levrault a detailed and accurate study of "La Force motrice animale à travers les âges". Using archaeological records, he gives a vivid account of the methods of traction, harnessing and shoeing practised in Assyria, Chal-

dea, Egypt, China, Greece, Rome, Arabia, etc. He carries the subject on to the Middle Ages and finally to our own times.

P. DE CHOIN. Stallion Stations (*haras*) Officer, who reviews this publication in No. 31, 1925 of *La vie agricole et rurale* refers also to information on the same subject, given by RINGELMANN, professor at the *Institut agronomique* in his "Essai sur l'histoire du Génie rural".

374. **United States : "Vanderbildt University" and the Lyon geological collection.** — The geological section of the above University has acquired this private collection, begun in the time of SYDNEY S. LYON and then continued by his son VICTOR W. LYON. It consists of some thousands of fossils, principally from the classical palaeozoic district of Kentucky and of Indiana, also samples of minerals, some hundred pamphlets and about three of four thousand works on geology and palaeontology, and is probably one of the few remaining private collections of the last generation. (*Science*, Vol. LXII, No. 1617, 1926).

375. **United States : Elements of Systematic Pomology.** — Mr. B. D. DRAIN who teaches in the Massachussets College of Agriculture, has published a textbook on systematic pomology which should prove equally useful to students and experimentalists as to fruit-growers who already possess an adequate scientific preparation. One chapter deals with fruit culture exhibitions. The book contains numerous illustrations and a copious index. (DRAIN B. D. Essentials of Systematic Pomology, pp. 284, large 16 mo., 106 illustr. New York and London, 1925).

376. **Great Britain : A Catalogue of British Scientific and Technical Books.** — This is a volume issued under the auspices of the British Science Guild, the President of which is Sir RICHARD GREGORY. The responsibility for the compilation of this catalogue rests principally with Miss D. SHAW, Secretary of the Cataloguing Committee, but a certain number of competent compilers have collaborated with her for some of the special branches. In a preface to the volume Sir RICHARD GREGORY states that the intention was to include in the publication all Scientific and Technical books issued by British publishers, excepting only those of a very elementary nature and those sold at less than two shillings. Every book issued up till the end of 1924 is included here. (A Catalogue of British Scientific and Technical Books. (New edition revised and enlarged. 489 pp. in small 8°. London, 1925. Price 12s 6d).

377. **Great Britain : A collection of the most important varieties of Wheat in existence.** — Prof. JOHN PERCIVAL M. A., Sc. D., of the University Section of Agricultural Botany, Reading, England, has prepared a collection, containing as many as 1300 specimens of wheat, mounted on small pieces of paste board 36 cm. × 28 cm. and contained in 13 boxes. This collection, on the model of the one at the Reading Experiment Farm, includes specimens from all over the world, and illustrates the great number of variations in this cereal. The collection, which is provided with an index, may be purchased from Prof. J. PERCIVAL for Lg. 100. (From a communication sent to the International Institute of Agriculture).

378. **Australia and New Zealand : Agricultural Machines and Implements.** — The Department of Commerce of Washington, U. S. A., has

published a monograph on this subject compiled by I. HOMS. The following subjects are dealt with: Topography, climate, soil, population, agricultural labour, statistics regarding the importation of agricultural machines and implements and the provision of agricultural utensils made in Australia and New Zealand. The general conditions of trade in agricultural implements are indicated and much useful information is given on principles of cultivation and on methods of production. (I. HOMS. Agricultural Implements and Machinery in Australia and New Zealand. Government Printing Office, 195 pp. 28. II. Washington, D. C., Price 25 cents).

379. **Italy: The flower industry.** — In a concise monograph Eng. STACCHINI gives us his observations on the state of the flower industry. He examines successively its origin in Liguria, which is the most important centre of Italian production (noting that it began some 50 years ago); the reclamation of unproductive land; the conditions created by the war; the peculiar characteristics of the Ligurian flower industry, the extended cultivation and general care of the flowers. In the second part of his monograph the author studies carefully his economic data; the cost of production, the sale price; the characteristics of the markets, agricultural credit and available capital. He adds also some commercial statistics, calculating that 30,018,000 kilograms were exported between 1907 and 1910 at 3 lire the kilogram representing a value of over 90 million lire. After the war (between 1921-1922) the author calculates that 4,378,561 kilograms of cut flowers were exported from the neighbourhood of Sanremo alone; between 1922-23 911,413 kilograms from this district and 7,152,091 from the whole of the Riviera Ponente, between 1923-24 5.230,583 kilograms represented the entire exportation of Liguria, as many as 4,894,537 coming from the district of Sanremo.

The author proposes, with a view to encouraging this important industry, that the flower-growers should be represented on the commissions dealing with international customs regulations: that freight trains should be reorganised and co-ordinated, with provision of refrigerating cars to prevent deterioration of the produce. (STACCHINI P. Sull'industria floreale. Thesis submitted to the Technical Commission for the improvement of Agriculture).

380. **Kingdom of the Serbs, Croats and Slovenes: Plans for the promotion of agriculture and for a general supply of electricity throughout the country.** — By provisions contained in a law dated June 17, 1925, dealing with agricultural and co-operative credit, loans of long expiration are made by the Bureau of Agrarian Credit (an autonomic administration established at Belgrade) to the co-operative societies of agriculture. The object of these loans is to promote the building of grain-elevators, dairies, drying appliances, manufacturing works for agricultural machinery and artificial manure factories and also the installation of other plants to meet rural requirements: further they are to encourage the production and testing of seeds, and the preservation of fruit and vegetables. It is also intended to establish a central electrical plant and to supply power to the rural districts. These loans may also be extended to hydraulic societies which undertake protection against inundations drainage and the canalisation of water courses. (*Službene Novine*, No. 133, 1925).

Journals and Reviews.

381. **The Kühn Archiv.** — After an interruption of six years this well known review has just published Vols. 9 and 10. In consequence of the reorganisation of the Agricultural Institute of Halle on Saale, it now appears in three parts, each dealing with three principal subjects : agriculture, animal husbandry and agricultural industry, directed respectively by VON FRÖHLICH, STEINBRUCH and RÖMER. The two volumes contain also the commemoration of the centenary of JULIUS KÜHN.

382. The "**Tropenpflanzer**" which is the organ of the Agricultural Colonial Committee (*Kolonial-Wirtschaftliches Komitee*), has, with the beginning of the year, added a sub-title : "*Zeitschrift für das Gesamtgebiet der Landwirtschaft warmer Länder*", to specify that the review not only deals with tropical agriculture questions, but with all general agronomical and zootechnical questions in hot countries. The review is published more frequently and is often accompanied by a supplement.

383. "**Die Landgemeinde**". — It is a new Austrian review started on 1 January 1925 and treats in an elementary form all problems regarding legislation, technique, agriculture and animal husbandry of interest to country and mountain Administrations. This programme is embodyied in the subtitle of the Review. (*Organ für Landgemeindeverwaltung und Landgemeindewohlfahrt Oesterreichs*). The Review is published once a month and is edited at Graz (*Heimatverlag, Salzamtsgasse*, No. 7) and the price is 8 shillings yearly.

384. The "**Fortschritte der Landwirtschaft**" (*Progress in Agriculture*) is a new fortnightly review edited in Vienna and Berlin by J. SPRINGER (*Wien I, Schottengasse* 4). Its collaborators are the Chairs of the Higher Agricultural School of Vienna (*Hochschule für Bodenkultur*) and the Austrian Institutes of Agricultural Experiments. The Directors are Prof. Dr. HERMANN KASERER and Dr. RUDOLF MIKLAUZ. Price : 6 Mks quarterly.

385. Under the title : "**Korrespondenz für Messe- und Ausstellungswesen**" a quarterly Bulletin of Exhibitions and Fairs is being published in Berlin. Editor : HARRY FRIEDLAENDER, *Berlin W 50, Bambergerstrasse 7.* Price : 5 Mks quarterly in Germany and 6 Mks abroad.

386. The "**Wiener Landwirtschaftliche Zeitung**" (*The Viennese Agricultural Gazette*) reached its 75th year on the 31 December 1925 and on the 9th of the same month the Printing House "CARL GEROLD'S SOHN", where the Gazette is printed, its 150th year.

387. The "**Tharandter Forstliches Jahrbuch**" is now published monthly; the yearly issue will amount to 384 printed pages instead of 288. Prof. Dr. BUSSE has been appointed Editor, in place of Prof. Dr. H. VATER, who has retired and given up the editorship of the Review.

388. "**Das Grünland**", organ of the Association for the promotion of the cultivation of marsh lands in Germany (*Verein zur Förderung der Moorkultur im Deutschen Reiche*) has published a special number, edited by the Union of the German Rural Associations (*Verein Deutscher Landeskulturgenossenschaften*). This Union, founded in February 1925, has as its scope the co-ordination of all activities directed to soil cultivation and its

prominent members are public or private companies interested in soil improvements.

This special number includes, amongst others, an elaborate article by Dr. BAUER, president of the Provisional Working Committee of the Union, on questions of modern agricultural improvements especially on landed properties of the German State. (*Sonderheft für Landskultur. Das Grünland*, November 1925).

389. " **Anzeiger für Schädlingskunde zugleich Nachrichtenblatt der Deutschen Gesellschaft für angewandte Entomologie** ". — Prof. DR. K. ESCHERISCH of Munich and Prof. Dr. F. STELLWAAG of Neustadt a. d. Haardt publish monthly a " Bulletin on noxious insects " which includes the " Bulletin of the German Society of applied Entomology ".

390. " **Mikrochemie** ". — An International Committee of public collaboration publishes at Vienna "*Mikrochemie*", a review dealing entirely with microphysics and microchemistry.

391. **The " Zeitschrift für wissenschaftliche Biologie "** (*Review of Scientific Biology*) includes Section *C* of compared physiology (*Zeitschrift für vergleichende Physiologie*) and Section *E* of scientific botany (*Archiv für wissenschaftliche Botanik*).

392. " **Die Volksernährung** ". — A new review published at Berlin dealing with scientific, economic, practical and technical questions inherent to the various problems of individual alimentation and that of demographic agglomerations. Chief Editor Dr. MAXIMILIAN WINCKEL (Berlin-Schöneberg, Meraner Strasse I). It is published the 5 and 20 of every month. Price: Mks 2.50 quarterly in Germany and 4 Mks abroad. It is edited by the Berlin Firm ROTHGIESSER und DIESING A. G.

393. **New American Journals.** — *The Pacific Coast Pacific Society*, in collaboration with the California Academy of Science, publishes a quarterly review called " *The Pan-Pacific Entomologist* ".

The International Museum of Saint Barbara in California issues a half yearly bulletin entitled: " *The comparative Oologist and Journal of the International Museum of Comparative Oology* ".

394. **Industrial and Trade Review for Asia.** — It is a new Review with the object of promoting Asiatic industrial development and commercial relations between Asia and other regions. It is published fortnightly in Berlin, Charlottenburg. (104 Reichstrasse), Germany. Price: 12/- per annum and 7/- for six months.

395. **Economic Geography.** — A new quarterly Review published in Massachusetts (U. S.) at the initiative of the Clark University. It is richly illustrated and contains many articles closely connected with agricultural economy. The most important are: W. B. GREELEY: Geography in relation with timber supply; O. E. BAKER: Geography and grain production; CLARENCE J. JONES: Canadian Grain Trade; G. R. STEWART: Rural police service on public properties; OLOF JONASSON: Study on demographic and rural maps; ELLS. HUNTINGTON: The distribution of domestic animals; C. C. COLBY; Apple industry in the Annapolis-Cornwallis Valley; O. JONASSON: Agricultural Regions of Europe; E. C. ANDERSON: Sugar-Beet industry

in Nebraska ; W. H. VOSKUIL : Utilisation of phosphatic resources in North America.

Price : 4 dollars per annum. Editorial Office : *Clark University, Worcester, Massachussets, U. S. A.*

396. **The "Revue Internationale des Tabacs"** is the title of a new monthly review edited in Paris (97, Rue Saint Lazare, Paris, IX^e) in which articles are published in the author's original language. It co-ordinates works sent in by any country, dealing with any question which have direct or indirect relation to tobacco. Detailed monographs will be printed on the tobaccos of Dutch Indies, Cuba, San Domingo, Kentucky, Virginia, Philippine Islands, Brazil, Paraguay, Columbia, Mexico, Tunis, Cameroon, Indochina, Madagascar, etc. The review contains sections on agriculture, industry, economics, legislation and will publish literary and medical articles on the physiological action of tobacco. Articles on historical archaeological and artistic research of this drug will be accepted.

397. **Veterinary Bulletin for Indochina.** — The *Bulletin Vétérinaire de l'Indochine* has started its quarterly publications and contains principally original articles, as well as reports, official informations, recensions, etc.

398. **The "Journal of the Pan-Pacific Research Institution".** — Its first number came out on 1 January of the present year and will form a periodical records of investigations on the food resource problems (production, distribution, conservation and consumption) of the Pacific Coasts dealing at the same time with the sanitary, demographic and ethnographic questions relating to the population of these regions. It will become also the organ of this large Institution created for the scientific and practical research work of the Pacific islands. The Central Editing office is at Honolulu, directed by Prof. F. G. KRAUSS of the Hawaii University. Correspondents : C. L. ALSBERG, University of Stanford ; C. F. BAKER, Philippine University ; P. J. S. CRAMER, of the General Agricultural Experiment Station of Java ; C. ISHIKAWA, Prof. at the Imperial University of Tokio ; Sir J. BARRETT, K. B. E., of Melbourne (Australia) ; E. D. MERRILL, of the California University ; G. M. THOMSON, M. P., of Wellington (New Zealand) ; S. T. WEN, of Shanghai ; C. P. SIDERIS, of the Hawaii University and R. H. van ZWALUWENBURG, of the Experiment Station H. S. P. A.

399. The **"Rivista di Malariologia"** is a continuation, on more independent lines, of the *Bollettino Malariologico* which used to form part of the well known periodical *Annali d'Igiene* edited by Prof. G. SANARELLI.

The new publication will however appear bi-monthly and will contain original articles with summaries in English and French, reports, etc., and a section for copious notes arranged on a systematic plan. The first number of 112 pages with four tables and many illustrations contains 7 original articles contributed by experts in problems of malariology.

Editorial and Managing office : Via Spallanzani 4, Rome (27). Editor in Chief, Dr. L. VERNEY. Subscription in Italy L. 25. Abroad L. 50.

400. **"L'Italia Agricola"** has published a special illustrated number on agricultural conditions in Tuscany. The various problems and the different agricultural aspects of this region are treated in each chapter as follows : Pedology, by MARTELLI ; Land reclamation in the Maremme, by

GINANNESCHI, in the Val di Chiana, by PELLEGRINI; viticulture, by TOPI; enology by OLIVA; olivegrowing, fruticulture, and silviculture respectively by BONUCCELLI, RACAH and MERENDI. A special chapter by FREGOLA deals with the Tuscan "*Gentil Rosso*" breed; with the special cattle breeds "*Chianina*" and "*Maremmana*" and with the pig breed "*Cinta*" all by DONDI. Agricultural economic conditions are described by GARAVINI and agricultural instruction and experiments by FERRARI. All these articles are preceded by a summary on agriculture in Tuscany by BELLUCCI. (*L'Italia Agricola*, Year 62, No. 12, Piacenza, 1925).

401. **Journal of the Department of Agriculture, Kyusku Imperial University,** is the title of a new bulletin issued by the Agricultural Section of the Japanese University in Fukuoka. It is published at irregular periods and contains signed articles in English and German.

Personal.

402. At the *Académie des Sciences* in Paris, M. BOUVIER commemorated TISSERAND, the oldest member of the Academy and ex Director General of Agriculture, who died last November in his 95th year. Appointed soon after 1870 Inspector general for agriculture, he induced the Government to establish the Practical Schools of Agriculture, which stand between the Farm-schools and the national schools already existing. He reconstituted in Paris the "Institut agronomique" which he directed until 1879. While General Director of agricultural services, TISSERAND did much to bring about the now existing far reaching organisation, especially as regards instruction and experimental work. Amongst his publications, the most note-worthy are those on plant life and cultivation on high mountains, and on the treatment of milk at low temperature. He was one of the first to interest himself in the question of practical experiments of anti-anthrax vaccination.

403. C. C. CALDER curator of the Herbarium in the Royal Botanic Garden of Calcutta has been appointed Superintendent of the Garden and of the cultivation of china in Bengal, and Director of the Botanic Services in India.

404. The death is announced of C. N. CATLIN, Professor of agricultural chemistry at the Arizona University and author of various works on soil chemistry.

405. J. G. COATES, M. P., Prime Minister of New Zealand, has accepted the honorary presidency of the *Pan-Pacific Union*.

406. The death of Sir FRANCIS DARWIN (1848-1925) in Cambridge, third son of CHARLES DARWIN, the great naturalist, ends a long series of fruitful work. He was an assiduous help to his father and in 1880 he published "*Physiology of Plants*". This book was followed by others dealing particularly with the localisation of the sensitive organs and the mechanism of transpiration. Sir FRANCIS DARWIN was instructor of plant physiology at Cambridge, transferring to this School his father's scientific library. His well known book "*Life and Letters of Charles Darwin*" (1887), completed later by "*More Letters of Charles Darwin*" (1903), has been judged as the best biography

ever written. He was a member of the Royal Society and of other important Scientific Associations and received degrees *ad honorem* from many British and European Universities. In 1912 he was awarded the Darwin Medal.

407. Eastern India has lost one of its most zealous sylviculturists by the death of JAMES SYKES GAMBLE, F. R. S., F. L. S. (1847-1925). From 1890 to 1899 he was Director of the Imperial Forest School of Dehra Dun publishing, during that period, several works on forestry. His "*Manual of Indian Timbers*", published in 1881, was reprinted in 1902 and 1922. In conjunction with Sir GEORGE KING he wrote "*Materials for a Flora of the Malay Peninsula*" and "*Flora of the Madras Presidency*" which, owing to the death of the Author, have not yet been published. JAMES SYKES GAMBLE was appointed to the Forest School of Oxford as lecturer on Indian Forestry.

408. Dr. ARTHUR GEORGI, successor to the well known editor PAUL PAREY, Berlin, has celebrated his twentyfifth year of editorial activity directed principally in support of agricultural and veterinary sciences. For his many merits the Higher Agricultural School of Berlin appointed him, in May 1925, on the occasion of his 60th birthday, *doctor honoris causa* in agriculture. The publisher's catalogue of the firm of PAREY contains an extraordinary number of works and reviews dealing with these sciences. Besides the former well known *Forstwissenschaftliches Centralblatt*, the following papers have been founded by the activity of Dr. GEORGI: "The Brewer's Journal" (*Tageszeitung für Brauerei*); "The horticultural world" (*Gartenwelt*); "Agricultural Machinery" (*Landmaschinen*); "Review of applied entomology" (*Zeitschrift für angewandte Entomologie*); "Zootechnical Review" (*Zeitschrift für Tierzüchtung*); "Review of agricultural and irrigation legislation" (*Zeitschrift für Agrar- und Wasserrecht*) and many others. The Prussian Ministry of Agriculture has for a number of years employed this Firm for its official publications; whilst, owing to the extraordinary activity of Dr. GEORGI, this Firm edits also for the *German Agricultural Society* the *Institute of Fermenting Industries*, the *Government Biological Institute for Agriculture and Sylviculture*, the *German Agricultural Council*, the *Prussian Agricultural Chambers*, etc. etc.

409. On the 31st January last, German potash industry lost one of its most important exponents by the death of PAUL ALFRED GRAESSNER, ex adviser to the Ministry of National Economy.

410. ROBERT M. GREY, Superintendent of the Botanical Gardens, Cuba, of the Howard Institute for Tropical Biology and Medicine, has been awarded the commemorative MEYER medal by the American Association of Genetics, for having introduced and cultivated in Cuba new varieties of sugarcane.

411. Sir JOHN HARRISON, who died on the 9th February last, took a very prominent part in the scientific and agricultural development in the West Indies and Guiana. In 1879 he was appointed professor of Chemistry and Agriculture at Barbados and since 1905 he occupied the post of Director of scientific agriculture in British Guiana.

412. G. W. HERVEY of the Rutgers University has been appointed biometer at the United States Bureau of Dairying for the purpose of collaborating

in the research of the laws governing heredity in the special functional aptitude of dairy cows.

413. The well known English authority on systematic botany, W. P. HIERN, F. R. S., died in his 85th year.

414. Prof. A. S. HITCHCOCK, curator of the U. S. National Herbarium, has been elected correspondent member of the German Botanical Society.

415. The death is announced of Dr. W. D. HUNTER, senior entomologist of the U. S. Bureau of Entomology and member of the Federal Horticultural Board.

416. Dr. HANS OSCAR JUEL, Professor of Botany at the Upsala University, and Dr. SVANTE MARBECK, director of the Botanical Gardens, Lund, Sweden, have been elected foreign members of the Prussian Academy of Science.

417. Prof. JEAN LUTOSLAWSKI, sub-editor of the *Gazeta Polnicza* and member of the Board of Directors of the "Union of the Agricultural Organisations of Poland" has been decorated with the Order of "Redeemed Poland" for his services in the development of national agriculture.

418. The Wm. Y. NICHOLS medal has been conferred by the New York Section of the American Chemical Society on Dr. S. C. LIND, one of the Directors of the Fixed Nitrogen Research Laboratory of Washington for his publication on the chemical action of the *alpha* particles.

419. J. H. MAIDEN, F. R. S., ex director of the Sydney Botanical Gardens, died at the age of 67 years.

420. JULES MELINE, ex Prime Minister and many times Minister in France, died in his 87th year. He was a great supporter of protection for French agriculture and author of several publications amongst which "*Le Retour à la terre et la surproduction industrielle*". It is due to him that the order of the "*Mérite Agricole*", was founded.

421. Dr. V. H. OUSSIMENKO, Veterinary Officer and Bacteriologist of the Island of MAUI in the territory of Hawaii, while experimenting in his own laboratory with haematic anthrax became inoculated with the infection and and succumbed to anthrax on 13 January last.

422. A. PARMENTIER, who is generally considered to be the founder of the celebrated Botanic Garden at Brooklyn (New York) in 1825, was commemorated in October last by the unveiling of a bronze tablet in this garden. However, as is remarked by C. STUART GAGER in *Science* (Volume XLII, No. 1612, 1925), Parmentier had established a nursery garden in the locality about a mile away from the present Brooklyn Garden which is now entirely built over. Moreover, although the old horticulturist had at the time given the name of the *Brooklyn Horticultural and Botanic Garden* to his establishment, there was no connection, either historical or otherwise, which could justify regarding the nursery garden of 1825 as the first nucleus of the foundation of the present celebrated Institute of Brooklyn Botanical Gardens, and in fact the installation of these gardens was mainly due on the contrary to the late ALFRED T. WHITE.

423. Sylviculture has lost one of its best known devotees in the death of PHILIBERT ROTH, emeritus professor of sylviculture at the University of Michigan.

424. Sir WILLIAM SCHLICK, K. C. I. E., F. R. S., German by birth and by education as he was born in the Grand Duchy of Hesse Darmstadt and took his degree at Giessen, Inspector General of Forests in India, died last September at the age of 85. He had served first in the Province of Burma as an official of the Indian Forest Department and then in Scinde, in Bengal and in the Punjab. In 1885 he was summoned to England to take up the professorship of Sylviculture (Royal Indian Engineering College, Cooper's Hill). On the closing down of this Institute in 1905 Professor SCHLICK was transferred to Oxford. His best known work is a Manual of Forestry in five volumes.

425. The National Association of Electrical Industries (L'Associazione Nazionale Industrie Elettriche) in Italy is taking steps to commemorate in a worthy manner the centenary of the death of ALESSANDRO VOLTA which took place in Como on the 5th March 1827.

426. Professor HENRY WATERS, President of the Kansas State Agricultural College from 1909 to 1917 and well known for his works on animal nutrition, died in October last at the age of 60.

427. The ornithologist and lawyer LEVIS B. WOODRUFF of New York has left his property to the Yale University for the benefit of the Museum. A permanent bequest of 10,000 dollars must however be set apart for the New York Entomological Society. The scientific collections and the natural history specimens belonging to the deceased have been passed to the American Museum of Natural History (*Science*, Vol. LXII, No. 1617, 1925).

428. Professor B. WUNDER, formerly director of the Seed Selection Station for the Berlin Agricultural Domain, has been appointed director of the *Estación Experimental de la Sociedad National de Agricultura* of Santiago, in Chile.

429. The Society of American Bacteriologists have elected the foreign corresponding members: WINOGRADSKY (Russia and France); BEIJERINCK (Holland); OMELIANSKY (Russia); NEUFELD (Germany); KITASATO (Japan).

Dott. G. A. R. BORGHESANI, *direttore responsabile*.

ORIGINAL ARTICLES

ON THE QUESTION OF THE STANDARDISATION OF WOOL IN THE PREPARATION OF INTERNATIONAL WOOL STATISTICS.

Following up a suggestion on the part of the Government of the United States of America, the International Institute of Agriculture at Rome has drawn up a memorandum, the object of which is the preparation of new and complete statistics regarding wools, the production and consumption, commerce and stocks, of the countries which are principally concerned as producers and consumers. This memorandum was sent to the Ministries, statistical offices, and a few associations and societies interested in wool. By this it is hoped to receive suggestions corresponding to the actual position of the countries and institutions concerned with respect to the preparation of wool statistics.

On page 4 of this memorandum the following remarks are made with regard to wool production: « In some important wool producing countries, for example in the United States of America, Australia, New Zealand and the Union of South Africa, production statistics are already published. It must, however, be observed that even where statistics of wool production exist, the information in general does not quite correspond with the facts. Further, from the point of view of the right time of publication, considerable delay often occurs, so that the figures are more of historic interest than of practical value for joint observation. Detailed description is mostly altogether lacking, or is seldom applied to the important differences between washed and unwashed wool, or to the type of the wool. It can therefore be said that (1) on the part of the governments of important producing countries, exact and exhaustive annual production statistics

must be prepared, and published without any delay ; (2) before the publication of these statistics, estimates must be made just as they are for products of the soil, and these must be published at the time when sheepshearing begins or is in course of operation, in order to supply the markets with trustworthy information ; (3) these advance estimates and statistics should contain all details as to the quantities of wool in the yolk, washed wool and other kinds, such as wool in the fleece, which is contained in the total amount given ; and in such a way that for every category a corresponding weight equivalent in washed wool is given, through which a unitary final sum is arrived at, which can be used for comparison ; (4) these advance estimates and statistics must at least give data as to the different kinds of wool. Until a unitary classification has been arrived at in this matter, a distinction between merino wools and cross-bred wools must suffice on the one hand, and between fine wools (comb or garment wools) and coarse wools (for carpets, mattresses, covers) on the other.

At point 4 of these observations, I may now be permitted to insert my contentions, and I consider it extremely desirable that if once such an extensive work is undertaken as the exact establishment of wool statistics for all the world, a classification as exact and uniform as possible should be used.

How has the classification of wool been carried out hitherto? On the one hand, one can point to the methods of wool examination as they have existed up to now, or do exist in practice or agriculture, and also as carried out in the wool-working industry, which largely consist of valuation by touch *with the hand*, and *by sight*, with the occasional assistance of *comparison with standard marks*. On the other hand may be mentioned the methods of wool examination which are used in carrying out *scientific examinations of wool* in the various University institutes, where it is mostly a question of establishing, *with the aid of the microscope, the fineness of the individual woollen fibres* in section or in general, the results of which examinations are afterwards made use of, in accordance with defined agreement, for making assortments. In order to give only a short example to show how the judging of the wool can be proceeded with so that sufficiently accurate results may be obtained for scientific investigation, I will now refer to the method of judging the body, fleece and wool of the sheep, which was, and is still in use for definite purposes in the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich.

The methods of the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich are founded principally on experiments made in Halle, like those in the Institut für Meteorologie und Pflanzenbau (Leiter Professor Dr. P. HOLDERFLEISS (Güldenpfennig) and in the Institut für Tierzucht und Molkerei (formerly Leiter Professor Dr. S. v. NATHUSIUS, now Professor Dr. FRÖLICH) — taking as a basis the excellent, old, practical methods of JULIUS KÜHN, BOHM and others, these latter throughout being the starting point of the new methods of examination of body, fleece and wool of the sheep.

A. — *Judging the sheep.*

(*a*) Breeding value.

The breeding value is determined with breeding charts at hand, with division into breeding classes (Roman figures) and determination of the general breeding value (coloured signs) (1).

(*b*) Body.

Judging the sheep takes place, after selecting a suitable standard, first by looking at it, then taking weights and measurements, by use of points and rectangular processes, using the most common abbreviations, by photography, etc.

B. — *Judging the fleece and the wool.*

(*a*) Fleece.

The fleece, the amount of wool and the wool respectively are judged according to a definite key. The following data are established consecutively:

(1) Degree of fineness and nature of pollution.

(2a) External quality of fleece (close, apparently close, open, wavy, impurity content).

(2b) Internal quality of fleece (even, falling, off, cut).

(3) Staple of the whole fleece (free and easily divided staple, staple difficult to divide, false binder, overgrowth, sedimented or felted near the skin, equally divided or equally formed, unequally divided, even texture, uneven texture.

(1) See HENSELER. Vererbungslehre und Zuchtbuchfuhrung. Verlag HOSANG. Hannover, 1920.

(4) Staple (height and length, tension of the wool, metal elasticity (feeling), diameter and closeness, form of body of the staple, needle fleece, wax points, etc.; internal construction of curliness in the staple: normal flat, smooth or highly curved, state of the staple: erect, oblique, hanging, open, wavy, surface of the staple, differentiation of various stages from short to long).

(5*a*) Strength of the wool coating (distribution over the body).

(5*b*) Wool coating on the belly.

(5*c*) Wool coating on the legs: (bare, to the hock, thick covering of wool).

(5*d*) Wool on the head.

(6) Hair on the face (merino-like, bristly hair, etc.).

(7) Pigment spots (some black or brown spots, fairly bright).

(*b*) Wool Fibre.

(8.) Classification of highest importance fineness, strength of fibre by parting the staple with the hand. In determining this according to sight and touch, points 9 to 16 must be taken into consideration apart from fineness.

(9) Yield (curliness: smooth, flat-curved, clear, highly curved, glassy), determined by blowing the staple apart (also 10).

(10) Character: (inclined to be too coarse, coarse, very coarse, i. e. harsh).

(11) Truth: (uniformity).

(12) Thread formation: (belly, belly and flank, whole fleece).

(13) Height and length of fibre.

(14) Colour of the fibre.

(15) Glossiness: silky dull, lustrons.

(16) Perspiration: (inclination to heavy perspiration, moderate perspiration, very loaded, yellow perspiration, wax perspiration).

(*c*) Skin and horns.

(17) Wrinkle formation: Free from wrinkles, indicated wrinkled.

(18) Ear: form, carriage, fineness.

(19) Other formations appearing on the skin.

(20) Horns: strength, form, position, colour.

(21) Finally, the weight of the fleece is determined immediately after shearing, and in air-dried condition. Points 1-16 are also decisive for judging the evenness of the fleece.

For further exact examination, samples of wool are taken from about seven parts of the body, namely, the *blade* (shoulder), the *flank* (last true rib), the middle of the curve of the loins, the withers, the nape of the neck, the *middle of the hind leg*, and the middle of the belly. The parts in italics are the most important.

For scientific purposes, the number of parts of the body to be examined (as a rule more than seven) is arranged according to the object of the investigation.

Manner of taking:

The samples, as far as possible of fully 2.5 cm. diameter, are cut off close to the skin, without pulling, so that they will keep the natural form as far as possible.

For exact judging, the wool, or say individual samples of wool and wool fibres are then subjected, one after the other, to the following examinations:

(1) Working up the wool fibres to a dry substance:

2.5 grammes of wool are kept for 2 hours in the drying cupboard at 98° C., and then cooled in the desiccator. This treatment is continued until constant weight is arrived at. The dry substance is then given in % of the raw wool.

(2) Determining the washing:

2-3 gr. of wool, by means of a glass rod in a porcelain vessel, are washed with ordinary water of room temperature until the washing liquid remains clear, then dried in the drying cupboard at about 100° C., and cooled in the desiccator to constant weight. The residue is then given in % of the raw wool.

(3) Working up the wool for yield:

(*a*) with 5 % soda solution: 2-3 gr. raw wool are first of all washed in the water bath in clean tap water, and then in 5 % soda solution, in which to one part by weight of wool there are about 40-50 parts by weight of solution. The washing in soda solution continues, with one change of solution, for one hour. It is afterwards washed with distilled warm water, until there is no longer any cloudiness in the washing liquid. The temperature of the washing liquid is kept at 50-55° C. by the water bath.

After washing, it is dried at about 100° C. and then cooled in the desiccator. This is continued until constant weight is attained.

(*b*) with ether:

The last residue of fat is drawn out by ether extraction, determined in accordance with the usual Soxhlet method. (These

quantities of fat, however, are so small — scarcely weighable — that this process can hardly be taken into account in practice).

The yield is multiplied by 1.17 (corresponding to normal moisture contents of 17 % water) and expressed in % of raw wool.

(4) Determination of the glow residue: 2-3 gr. of wool, combined with 5 % soda solution, are reduced to ashes in the platinum crucible, the residue being given in % of initial weight.

(5) Elastic reaction with chlorine water (*Allwörthen* reaction).

(6) Determination of curliness: Wool from which the fat has not been removed is smoothed with the curling knife (BLOCK and HARTMANN wool knives are available) and then the division is made into the individual grades of fineness (assortments).

(7) Determination of fineness: The determination of the fineness is made by the microscope, magnifying 1000-fold, with a micrometer value of 2.4;

(*a*) in survey (mostly for practical purposes).

(*b*) in cross section (for scientific investigations),

(*c*) With the aid of specific weight.

The cleaning of the wool fibres, which are microscopically examined, is done very carefully with ether or also with Carbonic Disulphide or Carbon tetrachloride.

As regards (*a*) determination in survey: Samples of 100 wool fibres each are obtained for examination. Glycerine free from water is used as bedding material. Should the uniform structure of the wool have to be specially investigated, then the diameter of the fibre is measured at as many places as possible; otherwise, each of the wool fibres in the lock is measured in three places, namely, at the base, the middle and the point, special care being taken that the measuring place and onwards is to a great extent of fairly similar nature.

Elaboration of the counting material: From the counting material obtained for normal use especially the arithmetical average is usually determined. Under special circumstances, however, particularly in scientific investigations, the average deviation from mean value, or the standard deviation, is also calculated. Finally, the maximum and minimum counts are given, and their differences, and generally speaking all biometrical methods are used as necessary.

As regards (*b*) In cross section: The wool fibre is bedded in unheated paraffin of a melting point of 60-65° C., and cut with the microtome. The cutting is examined, in glycerine free from water,

under the microscope. The number of the fibres examined is 100; as above with (*a*). Optionally, either many fibres, at least 100, are examined, taking one cross section from each, or (*b*) several cross sections are taken from each of a smaller number of fibres.

Elaboration of the counting material in these cross section examinations: Calculation of the arithmetical average, otherwise as above.

In scientific investigations the geometrical mean is also used, for comparison and to prove the method.

(8) Determination of physical qualities:

For investigating the physical qualities, in addition to the old apparatus of *Menzel*, *Bohm*, *Güldenpfennig* amongst others, the «Deforden» apparatus from Krais-Dresden is used in accordance with instructions. Amongst other things are determined: Durability, carrying power, elasticity, torsion capacity, with which recently time exposure photographs have been used as an assistance.

(Permanent preparations are bedded in xylol, as glycerine in time absorbs water).

It must, however, be further mentioned here that most of the other animal breeding institutes of Germany (and of course other countries also), e. g. the Universities of *Halle*, *Leipzig*, *Göttingen* and *Breslau*, the Agricultural High School of *Berlin*, the Veterinary High School of *Hanover*, possess regulations and instructions for the valuation of wool, which in thoroughness and originality leave nothing to be desired. It is obvious, however, that the methods used for scientific purposes are utilized slightly or not at all in the way of being introduced into the broad practice of the breeding world, or in producing necessary results in a short time in trade and industry. Still, as mentioned at the beginning, valuation has been introduced into the practice of agriculture, trade and industry, principally by touch and sight, and occasionally with the aid of standard marks. But this valuation by touch and sight, as at present carried out, cannot be satisfactory, and cannot be taken as a standard, for a general valid classification of wool, such as appears to be necessary for the preparation of wool statistics by the International Agricultural Institute of Rome. This valuation by touch and sight is individual, and must vary in each case according to the views and capability of the judge. It cannot be doubted that there are certain men with a special gift, who really can give a serviceable valuation bye touch and sight, whose classification of wool can and must be taken as standard for definite commercial and manufacturing purposes

But beyond these, there is an army of breeders and other experts, to whom the valuation of wool means a question of livelihood and who can and must demand that an objective valuation be carried out, which all can understand and make use of without further trouble.

In order to discover such a method, there has been carried out in the last few years, in the Institut für Tierzucht und Züchtungsbiologie der Technischen Hochschule München, at my suggestion, and under my guidance, extensive work which leads to the conclusion that an apparatus has now really been constructed which makes possible this long desired objective wool classification, so far as is technically practicable, and in such a way that its introduction and operation in agricultural practice, also sheep breeding, in trade, and also in the wool-working industry, can present no difficulty. It is above all owing to the service rendered by Diplomlandwirts Dr. HERBERT DOEHNER of Chemnitz, in constructing a special form of Trichinoscope, that this method is capable of being realised in practice. Details of the method are to be found in the treatise entitled: « *Eine neue Methode zur Feinheitsbestimmung von Haaren und ihre praktische Auswirkung zur Sortimentsbestimmung von Schafherden, anwendbar auch auf die Bestillung der Feinheit von Textilfasern* ». (A new method for determining the fineness of wool fibres, and its practical working in determing the sorting of flocks of sheep, also applicable to the determination of the fineness of textile threads). The work was registered at the end of 1925 by the Technischen Hochschule München as *doctoral* work, and is already in print.

The substance of this Munich method is only briefly described here, and attention drawn to its special advantages. For the sake of simplicity I confine myself partly, in the following deductions, to passages from the Doehner work.

The following is said on the *description of the apparatus* and its *origin*: « It is obvious that, on account of the natural smallness of the object (wool fibres) one cannot work with the naked eye in measuring, but must use enlargements unconditionally. For the foregoing practical aim a microscope is not of much account, as it requires a certain amount of training. If, therefore, a new workable method is to be created, then to begin with it must be realized that in practice there can only be used a process which is not only free from science, but must be so formed technically that it can be carried out by anybody, even the unskilled. It is of course natural that if a matter with such requirements is taken in hand, there must from the beginn-

ing be certain limitations. In this it is absolutely correct to differentiate between a process the object of which is to determine the *assortment of great masses of wool*, or to carry out the *classification of great masses of wool*, that being the problem which it was sought to solve, and *scientific examination of individual fibres* with the object of studying histological or other circumstances in connection with the fibre. The latter requires very much greater exactitude, a complicated optical system, and consequently, of course, greater magnification. All these, however, are accompaniments which cannot be worked with on account of high cost, or insufficient training of the person making the examination. It must also be borne in mind that even in the case of the skilled worker, it is easily understood that the making of a great number of microscopic measurements in time becomes an impossibility, because, amongst other things, the eyes become so tired that the exactness of the measurements suffers considerably thereby. Recently special attention has been paid to this on various sides, and it has also been sought to remove this evil by making measurements on projected pictures (1).

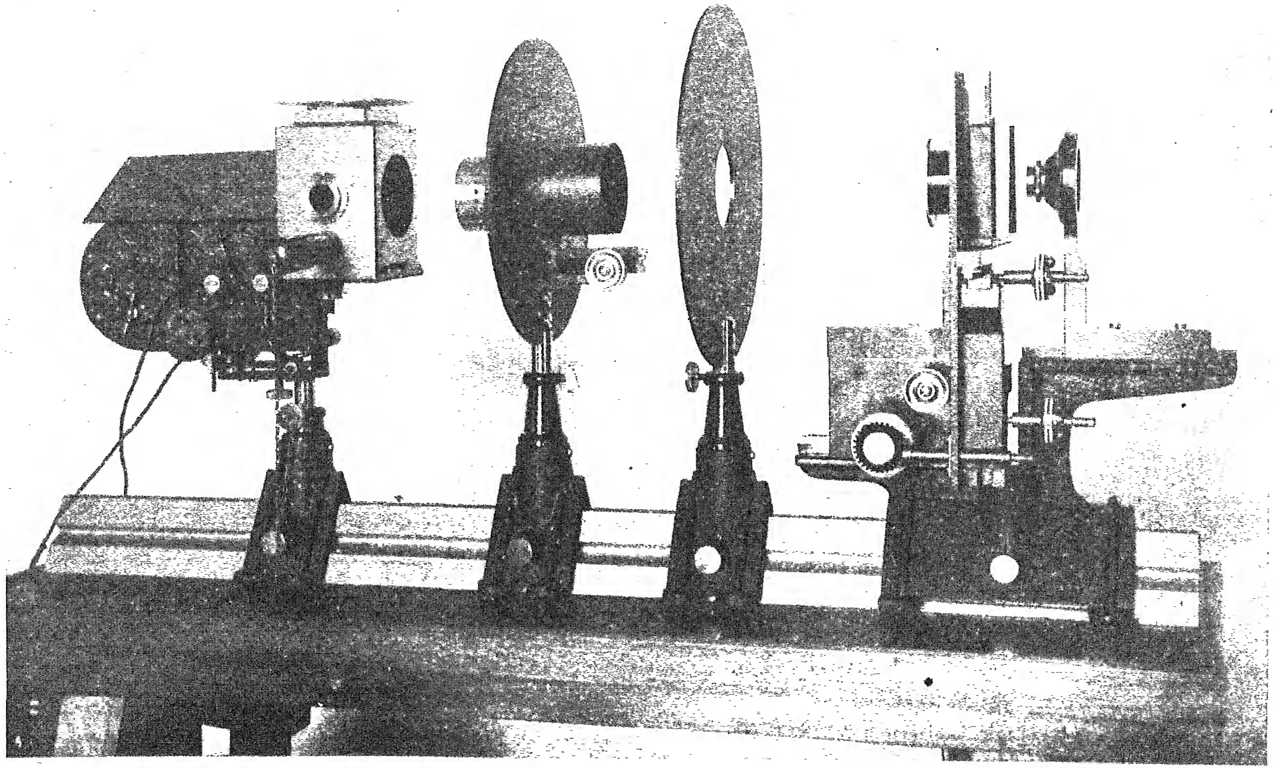
There remained, therefore, nothing else to do but to look round for another *new* apparatus which would enable the object to be attained. On the occasion of inspections of the Slaughter-house and Cattle Yard of Munich, *trichinoscopes* were introduced, whose build and construction appeared specially suitable for being applied to examinations of wool. The method of working with the trichinoscope is, very simply, as follows. The meat to be examined is pressed between two glass plates, and thereby the difficult cutting of the skin is avoided. The projected picture of the prepared substance then permits a wide field of survey, in which the trichinae can be sought without force. If, instead of the meat preparation, a wool preparation is put in the light-cone, then the picture of the wool appears on the screen as a great field for survey, and gives the possibility of exact measurements at hundreds of places.

The apparatus constructed by the firm of LEITZ, of Wetzlar, in accordance with the proposal of Dr. DOEHNER, is composed as follows, and as can also be seen from the accompanying illustrations 65, 66, 67.

As the source of light an arc lamp is used, with light-tight frame and special collimator, of a strength of 8 amperes. It can be attached)

(1) C. NAUMANN. Die Bestimmung des Feinheitsgrades von Wollhaaren nach Messen an ihren Projectionsbildern. *Zeitschrift f. Tierzucht u. Zücht. Biol.*, Bd. 3, Heft 1. Verlag P. Parey, Berlin.

with the corresponding resistance, at *every* lighting circuit. By means of a clockwork regulator the lamp burns evenly for hours together, without it being necessary to regulate the carbon. This regulation must be certain of fulfilment, for, as will be pointed out later, the measuring work is carried out at a distance of several metres from the apparatus, so that attending to the same would always mean an interruption of the work. In front of the arc lamp there is a screen which prevents any light escaping at the sides, so that the remaining space keeps perfectly dark, and consequently the projected picture appears clearcut on the wall. The crossbeam situated farthest forward carries a large cross-table, which permits of both a horizontal and a vertical movement, so that the preparation received on this cross-table can be observed in its full extent. For receiving the object there is a specially constructed « Cüvette ». This consists of a glass cistern with three divisions. The three divisions make it possible to prepare samples of the side, shoulder and leg of a beast for measurement at the same time. Each division is furnished with guides for receiving two glass plates, between which is the wool for examination. The « Cüvette » is made entirely of crystal glass, and allows the light falling parallel to pass out again. The optics of the apparatus, placed immediately in front of the preparation, consist of a microsummar of 24 mm. focal distance for small enlargements, or for greater enlargements there can be inserted objective 3 etc., in the same thread, as with the microscope. For great enlargements there is a special wooden frame for receiving the object-carrier for wool preparation and cover-glasses. The microscope objectives above number 3 are very long in their construction, so that it is no longer possible, on account of the thick glass wall of the Cüvette, to get near enough to the object. The result of this is a picture which is not sharp. With the frame arrangement, however, as the thick glass wall is done away with, a sharp impression can be obtained without trouble. The projected picture is now obtained by a screen specially constructed for the purpose of measuring. (Illustration 67). In a circular frame there is stretched a parchment paper, which is furnished with millimetre division squares, also millimetre paper. After exhaustive investigation, it appeared that it was best to project the picture through the screen, and then work out the measurements at the back of the picture. One can thus stand directly in front of the picture, and therefore vertically opposite it: If, however, it were desired to measure in front of the screen, one would be in the



Lighting lens. Diaphragm. "Cuvette" table with "Cuvette" "Cuvette" Objective.

FIG. 65.—Lighting arrangement.

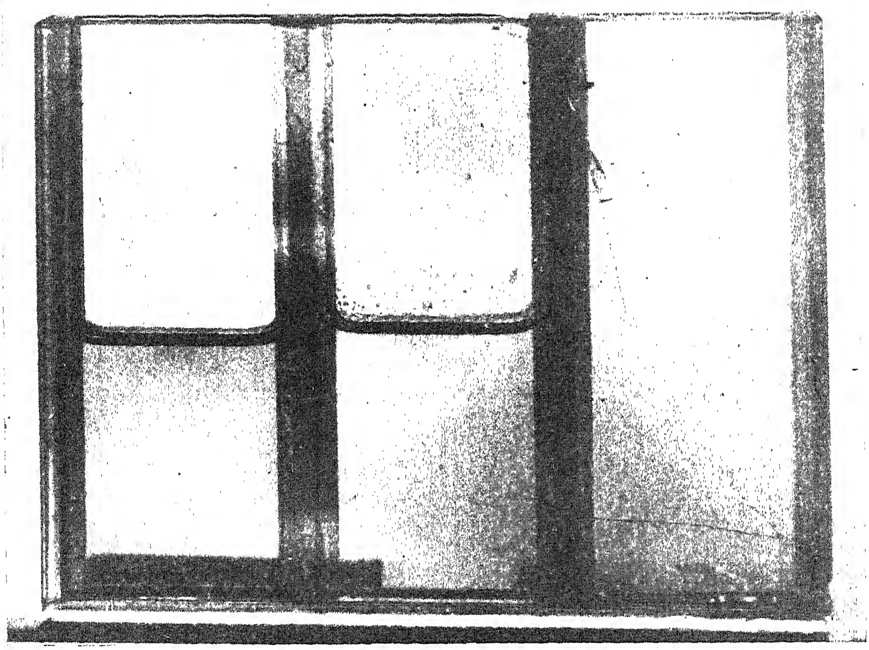


FIG. 66. — "Cuvette" divided into 3 sections corresponding to the 3 samples of wool to be taken from the shoulder, side and leg, filled with thinned cedar oil; the right compartment contains the glass plates between which the strands of wool have to lie. The two other compartments, left and middle, are here on the picture without glass plates, only half filled with cedar oil.

Plate XVIII.

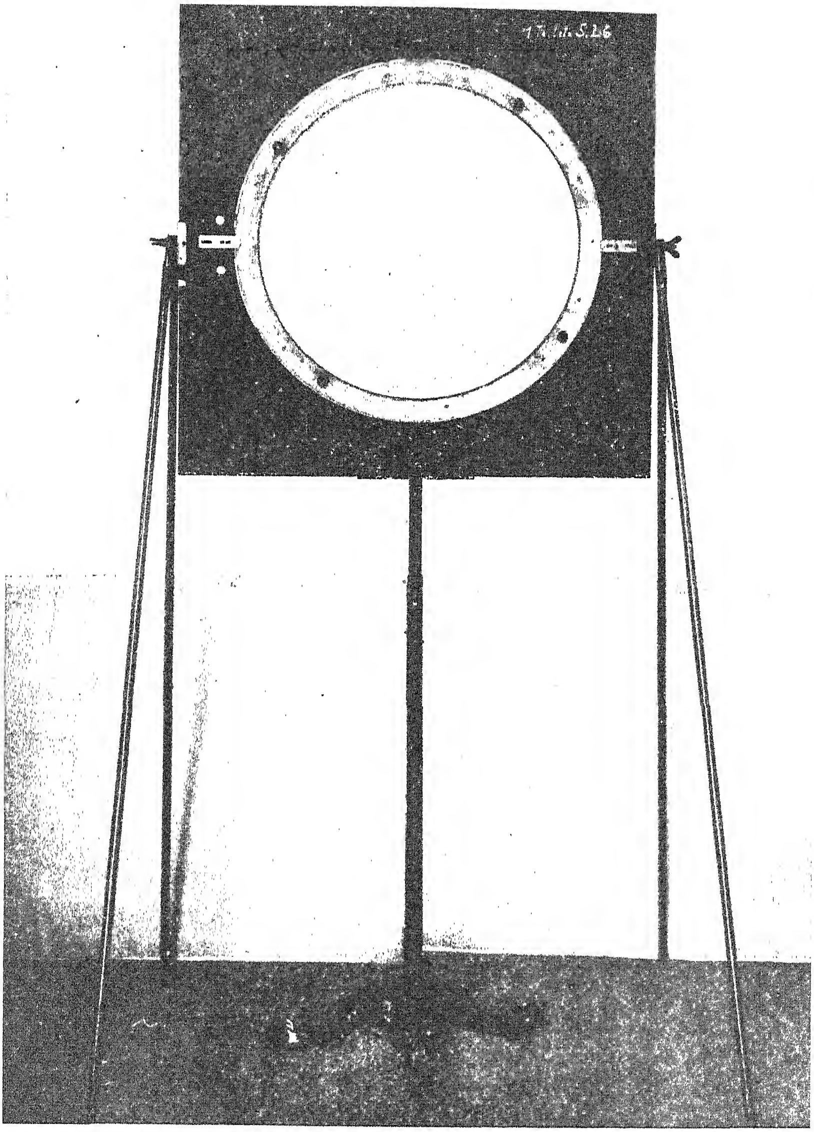


Fig. 67. — Screen, revolving in ball bearings, spanned with coordinate paper coated with paraffin, for receiving the projection pictures or the pictures of the standard marks.

light, and to avoid this, only a side view of the picture would be possible, which, however, would lead to inaccurate readings. In order to obtain a clear picture at the back, the parchment paper is coated on both sides with a thin layer of paraffin. The frame with the stretched paper now runs in a revolving guide, so that it is possible to carry out measurements everywhere, that is, at every part of the screen. Technically the measuring is then carried out in such a way that the screen with the division revolves until it is possible for one side of a millimetre square to cover one side of the hair to be measured. It is then easy to read off its thickness by the number of the covering squares. The division strokes can then be calculated easily in micro in accordance with a gauge to be described later. The lie of the hairs in the field of vision is thus a matter of perfect indifference as regards the measurements, because by the revolving system measurement is possible anywhere. This arrangement is preferred to the otherwise usual measuring with a specially arranged ruler, as it is considered simpler, and quicker to operate. The screen is firmly fixed laterally by rods, so that it remains quite still even when the measuring disc is revolving. According to the desired degree of enlargement, the screen must now be placed at a different distance from the apparatus, but always at a greater distance than that at which one could regulate it. It is therefore necessary to have also a check controlled from a distance both for the vertical and horizontal motions of the Cüvette, and for the sharp checking of the object. The ends of this check run into knobs which are fixed on the measuring screen, so that the person engaged there can make use of the apparatus without getting up, i. e. can comfortably work the check.

We must now describe the technique of large scale examination by the apparatus.

As regards taking samples of wool from the animal itself, the Investigation Committee for Methods of Wool Examination of the German Agricultural Society of Berlin at the Autumn Meeting at Würzburg decided that three samples shoud be taken. The selected samples are cut from the left side of the animal (in case the wool on the left side should be damaged, the samples are taken from the right side).

The samples are taken:

(1) From the shoulder in the middle of the shoulder-blade, high up.

(2) From the middle of the side, at the last true rib.

(3) From the middle of the leg, two fingers away from the socket.

The size of the sample, for microscopic examinations, must be at least 3 cm. in diameter.

Each sample comes in a small paper bag by itself, and this bears an inscription giving the part of the body whence it is taken. All three samples from one animal are stored away in one large paper bag. On this must be given the number of the animal, and anything else which is necessary, according to the purpose of the examination. It is of great importance that the samples of wool should be well prepared for examination in the above manner, as otherwise they might easily be separated from each other later, or be exchanged, and so inaccurate or quite false results obtained. From each sample of wool a little strand is now taken as carefully as possible, so that the texture of the staple is not destroyed. The fat is now removed from this strand by ether, and a wide camel-hair brush is passed over it several times, until the greater part of the dirt is removed. The main thing is that the structure of the strand should not be completely destroyed. It is absolutely necessary that this should be seen in the picture projected later.

The wool prepared in this way is now laid between two glass plates which must be perfectly dry and clean. These must be pushed slowly into the guides of the "Cüvetta" which has been filled with cedar oil, so that the oil can distribute itself evenly everywhere, without one blowing. Such would be the case if the plates were still greasy from previous examinations. It is therefore absolutely necessary that they should be cleaned perfectly after the examination. Sulphuric acid is most suitable for this, and, for the sake of cheapness, the so-called technical acid, which is not yet cleaned. To obtain still better cleaning of the plates, a little bichromate of potassium is added. In practice the cleaning process is very simple. The glass plates are simply thrown into a pot with the sulphuric acid prepared in this way, and the next day they are taken out again with a pair of pincers, washed with water, and dried.

If the three samples from the sheep have now been prepared for measuring in the "Cuvette", this can be proceeded with. The actual measuring is preceded by an observation of the structure of the staple as a whole, in order to see how it shows the strand in its whole course. For this it is best to take a low enlargement (microsummar 24) and thus get better general views. This can be observed

either on the screen itself, or a sheet of white paper can be put at any point on the path of the light rays, according to the enlargement desired, on which the desired staple structure can be observed.

At this point something further must be said as to why individual fibres are not examined, but the small strand of fibres left complete in its natural combination. As regards preparation for the examination of individual fibres, first of all this wastes a great deal of time, and what is of still greater importance, it carries with it tremendous sources of error. The Hanover process (1) requires that the individual fibres should be stretched out, so that when they are measured in air, they are found stretched straight under the microscope, and can so be measured. This straight stretching of the fibre is now very difficult, however, because in the first place, with a fine fibre it cannot be seen at all accurately with the naked eye whether all curling has disappeared from the fibre. The result of this will be that there will be further drawing out, and consequently the fibre will be involuntarily lengthened and its cross section thus altered. This will occur still more easily if it is required to uncurl the fibre in combination, which is absolutely necessary in measuring the cross section.

If curly lumps are also present, then with the finest bedding-in process it will no longer be possible to get cross sections. The results of this are deep cuts with entirely inaccurate measuring results (2). MANNSFELDT in his work on the uniform structure of the wool fibre in the Würtemberg improved land-sheep, with contributions on the technique of wool examination (3) notes that by drawing the fibre out of curl, the lower end of it is already tensely stretched whilst the upper end is still not uncurled at all.

Further, he makes a practice, as does also DOEHNER, of observing the fibres in combination, remarking that in measuring the individual fibre in its whole length from the point to the base, great fluctuations (8-10 micra) of cross-section occur. This is a proof that it is not possible to determine the assortment accurately by merely, as

(1) C. KRONACHER. Neues über Haare und Wolle. *Zeitschr. f. Tierz. u. Zücht. Biol.*, Bd. 1, Heft. 1, 1924.

(2) KRONACHER SACHSINGEN und SCHÄPER die Wollefeinh. Best. am Querschnitt. Bild. u. i. Projekt. Bild. *Zeitschr. f. Tierz. u. Zücht. Biol.*, Bd. 2, Heft 3, S. 224. August 1925.

(3) MANNSFELDT. Untersuchungen über die Treue des Wollhaares beim Württemberg, veredelten Landschaf m. Beitr. für Techn. der Messung, der Wollfeinheit. *Zeitschrift f. Tierz. u. Zücht. Biol.*, Bd. 4, Heft 1 und 2. June 1925.

in the *Halle* process for example, cutting off the lowest millimetre of the fibre and then taking measurement of this piece.

The result of the MANNSFELDT investigations, as laid down on page 160 and following, says: « The wool fibre of the ram is almost of equal thickness throughout its whole length.

With the ewe, however, it is finer towards the base.

The reason is to be found in a regular nourishment of the ram during the whole year, as opposed to an irregular nourishment of the ewe. In comparative examinations of sheep left out grazing, it appeared that an irregular nourishment, such as is caused by roaming the pastures, has a greater influence on the strength of the wool fibres than on gestation and milk secretion ».

The refinement of the fibres towards the base will perhaps not be so much in evidence with the finer and more even wools as was the case with the Mannsfeldt examinations of the Würtemberg improved land-sheep. Still, attention must certainly be paid to this factor in the methods of wool examination. The variation in strength of the wool fibre in its whole course is also plainly to be seen if the projected picture of a little strand, enlarged from top to bottom, is observed. These proportions can only be got correctly if measurements are made of every section of the fibre from point to base. This is most easily possible, however, if one has before one the whole combination of the staple, because in all parts sufficient possibilities of measuring can be found. It can at least be claimed that the measurements so obtained come as near to the actual proportions as is within the reach of possibility. All other methods, such as measuring the smallest cuttings of wool fibres (Halle), or measuring cross sections of them (Hanover) necessitate in order to do justice to these conditions, the taking of samples from different parts in the length of the fibre from top to bottom, or an attempt — which would be different in each breed — in a preliminary examination to find places where all the fibres showed the same length in relation to the cross-section. Of course the latter would take a very great deal of time in carrying out the method technically, and so make the work unprofitable. Moreover, the search for such faultless parts is only a makeshift, and as such should be little used. A further advantage of the use of the whole strand, retaining its complete natural proportions of construction, is that the character of the curling can be at once determined in the picture. The curling locks, in the places where the wool fibres still hang together, will be strongly marked in the picture, and can

easily be judged. One can even go further, and maintain that it is superfluous to take measurements, and for judging a flock it is sufficient to work on the general impression of the structure of the staple, and determine the assortment in accordance therewith. According to the strength of the wool fibre the picture of the strand will sometimes be quite typical, and sometimes not true to type. If now *standard pictures* of each assortment, prepared by a photographic method to be described later, are produced, then it is an easy matter, by comparing the projected picture with the corresponding standard picture, to determine the required assortment. It requires nothing more than a good eye, and after a little practice this method of determining assortments can be carried out even by people who are laymen in wool valuation. The time which this examination requires is then the least possible and amounts to only a few seconds. The general view of the staple, moreover, shows all the diseases and changes which often occur in the wool fibres, and the recognition of which is of such great importance for the wool-using industry. The Munich method also allows one to study the formation of thread marks.

In making observations with these pictures giving a general view, it is far better not to have the enlargement too great. In the Doehner examination it is assumed that fifty to sixty-fold is quite large enough. If the enlargement is carried further, then only a few individual fibres are presented sharply, because the wool, of course, lies quite freely in the "Cüvette" between the two plates, and is only exposed to the adhesive pressure between the two plates, so that the fibres lie in different optical planes. The result of this is that naturally only one plane can be focussed sharply, and obviously a perfectly sharp general view of all the tibres is never obtained. Then the field of vision must certainly be changed, which is necessary without further ceremony. Great enlargement comes into account in measuring in another connection, and its use will be described later.

At the place where otherwise the two glass plates with the sample of wool are pushed into the "Cüvette", an object micrometer (division etched on a object-carrier mm. 1 in 100 parts) is inserted, and this division projected on the screen. By comparing the projected division with that fixed on the screen, the micrometer value is then obtained, which of course is only valid for one and the same enlargement and one and the same distance of the screen from the apparatus.

Example of the calculation:

10 parts of the projected division are covered by 19 parts of the

division of the screen. The calculation of this result then gives a micrometer value of 5.26. The number of the division marks on the individual fibres found by the measurement must therefore in this case always be multiplied by 5.26 in order to get the strength of the fibre in micra. In the above calculation the 10 projected division mark had to be again multiplied by 10, as the division on the object-carrier is only made so that one division mark bears 10 micra. At the micrometer values of the microscopic measurements, there enters therefore the division of the screen, and the object-micrometer is not on the object-table, as with the microscope, but in the « Cüvette » at the position of the object.

As regards the measuring, this, with a little practice, is very easy to carry out. In accordance with the DOEHNER examinations, it is best for the measurement to be done with 183-fold enlargement, therefore with a micrometer value of 5.26 and a distance of the measuring screen from the apparatus of 295 cm. The bedding in cedar oil then ensures that the fibres can be focussed perfectly on the screen, without shadows on the edges, and thereby exact measuring results obtained. This would not be the case if, for example, glycerine were used for bedding in, as then too large black shadows would lie on the edges, and make the measurements inaccurate. The cedar oil is the same as is used for oil immersions, but of a certain thinness. In commerce it is known as « cedar oil for clarifying microscopic preparations ». As already mentioned above, the fibres by being bedded without force in the « Cüvette », are found in different optical planes, so that always only one plane can be sharply focussed. This is then focussed in measuring, and all fibres are measured which are sharply imaged, in order then to focus sharply another plane. In the work some care must be taken that the staple is drawn through the field of vision in its whole course, so that the measurements may extend regularly over the whole course of the staple, and calcutions made of any strengthening or weakening of the hair at any part of it. It is always best to measure from the points of the hairs (i. e. from the uppermost end of the staple) onwards to their ends, so that in comparing the individual measurements you always have before you the same parts of the group.

For the sake of accuracy in the measurements, and with the object of achieving greater speed in the work, it is very useful for one examiner to carry out the measurements, and another to note down the results.

The testing of this new Munich projecting method by comparing it with the measuring methods of other institutes showed the completely satisfactory utility of this method for carrying out measurements. A comparison of the results of the Munich projection method as they were read off the projection scheme, with the results as found direct in the microscope, showed no great difference in the findings, so that in this respect also no objections can be raised to the projection method. Another considerable advantage of the Munich projection method for measuring is that the material for the measurements is given in such a way by projection of the whole staple, that it corresponds to the actual conditions on the body of the animal or in the wool samples of commerce, and cannot be influenced by a voluntary or involuntary selection in taking samples of fibres for the microscopical examination of individual fibres.

It must again be expressly stated here, however, that in the first degree this Munich method has been worked out in order to get as perfect as possible a picture of the wool, in the presence of which a quick, objective carrying out of wool classification, free from objection, is possible in the practice of sheep breeding, commerce, and the wool working industry, and not simply for the purpose of investigating or measuring the fineness of the wool fibre.

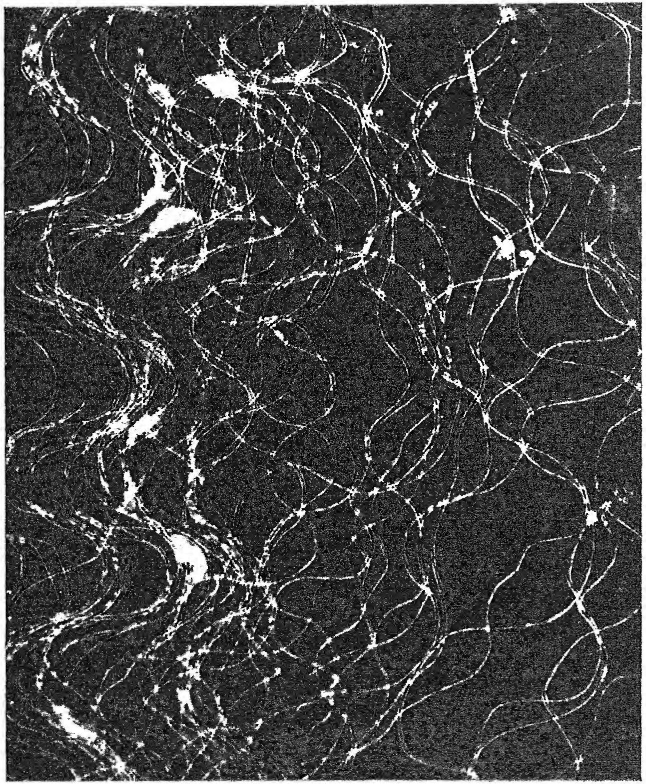
In conclusion, I would draw attention to a few special advantages offered by the Münich method or apparatus. Above all, it is absolutely necessary that the sheep breeder should penetrate more into the secrets of the wool. The profit in sheep breeding depends for the greater part, at least in certain directions of breeding, on the production of wool which is as valuable as possible, or which can be well utilized. The structure of the wool fibre or of the fleece of the animal, is also at the same time an external indication of the hereditary qualities lying in the individual. The accurate examination of the wool can therefore give a picture of the breeding standard of the flock; breeding unsuitableness and faults of any kind, false curling, appearances of degeneration, etc., can be immediately recognized in the picture of the wool fibre of the animal concerned. Before all, stress must here be laid on the great importance of seeing that the wool to be produced shall show an undoubted regularity or better uniformity, and on the fact that the picture of the strand or staple produced by the Munich method gives definite information regarding this uniformity. As regards determination of the assortment, it is impossible in practice to carry out direct microscopic measurements

of the fineness of wool fibres in the mass. With the Münich method it is easily possible to obtain pictures giving a general view, which even by themselves, but still better after comparison with standard pictures, put the observer in an excellent position to determine the classification.

Such pictures can easily be made into permanent photographes costing only a few pence. One simply puts a frame with gas-light paper (Leonar extra hard, for example, does very well) in the light-cone of the apparatus, lights up for a few minutes, develops, and then has a perfect photograph, true to nature, of the wool concerned. If, therefore, examinations of wool are carried out at any institute for the advancement of breeding, it is easy to forward to the sender of the wool sample a picture from which he can obtain much valuable information for his breeding. In the appendix to the DOEHNER work, pictures of such photographs are reproduced, which are also given here at the conclusion of my observations. They are illustrations of wool, from the finest merino to the coarsest land-sheep, from the collection of wool of the Institute for Animal Breeding and Breeding Biology of the Technical High School of Munich, which to some extent have served, or may serve as standard pictures.

Photographs are also taken of wool and cotton yarns, therefore of manufactured wool, and it is seen that in spite of the thickness of the object, very good pictures can be obtained. Of course, the photographs must always be taken at the same distance, and with the same objective, otherwise they cannot be compared with each other. The pictures published in the DOEHNER work were made at a distance of 109 cm. of the picture from the apparatus, a 43-fold enlargement, with the microsummar 24 mm. focal distance. (The illustrations were then, in the printing, reduced to $^3/_4$ of their natural size). If a glass plate, with etched millimetre division, is laid on the photograph, then with this there is quite a good standard of comparison for thè thickness of the individual fibres. The pictures also show the course of the curling, so that direct curling studies can also be made. If such general views are now prepared of fibres of every assortment class, which have previously been measured accurately to show to which assortment or quality class they belong, then standard pictures of assortment or quality are obtained in a comparatively easy manner, as has been repeatedly mentioned before. Certainly, the projected pictures of the samples of wool which are to be examined, when compared with these standard pictures, do not always represent pure as-

FIGS. 68-79. — *General view of classification pictures arranged according to breeds, taken from the collection of wool of the Institutes für Tierzucht und Züchtungsbiologie of the Technischen Hochschule München. Obtained in the light-cone of the Doehner apparatus.*



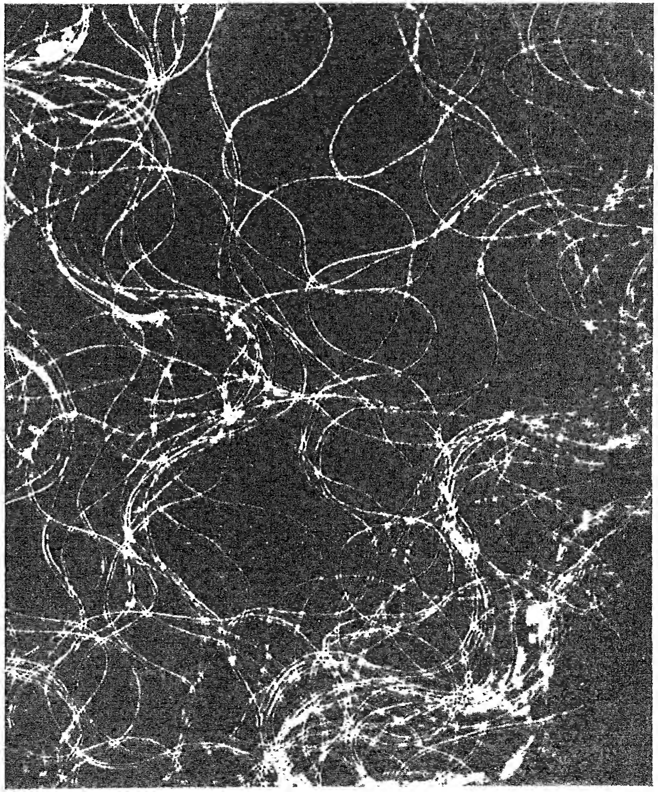


PLATE XX.

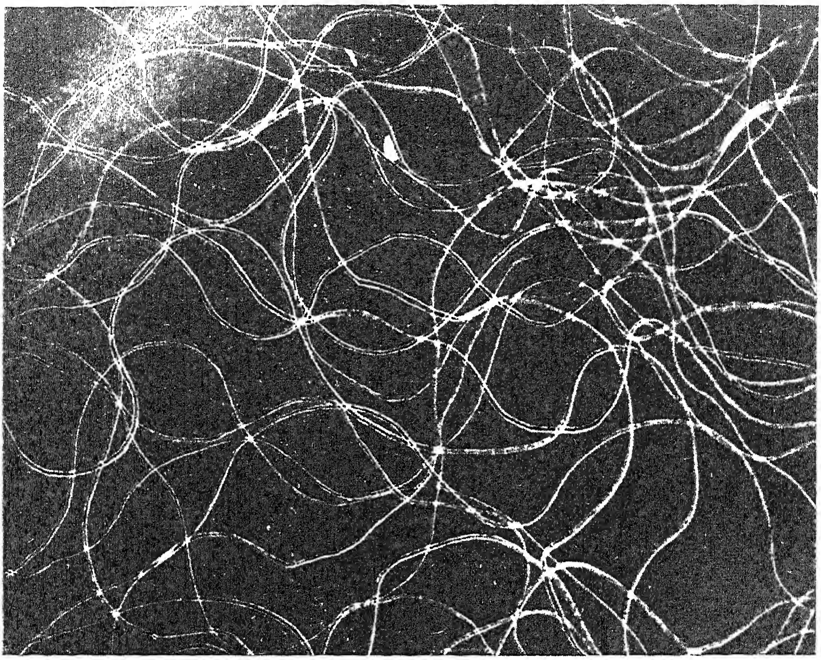


FIG. 71 — German meat-wool sheep.

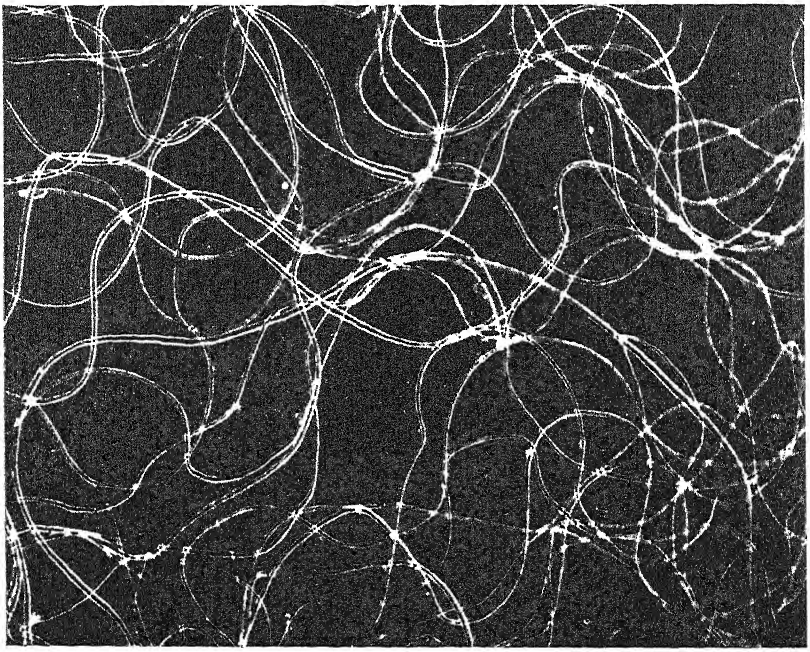


FIG. 70 — Rambouillet.

PLATE XXI.

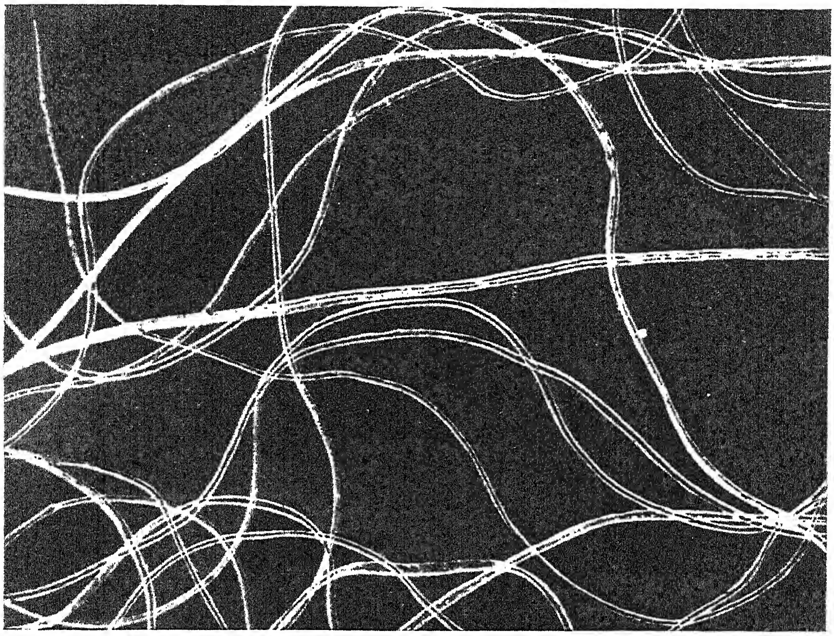


FIG. 71.—Rambouillet Ram.

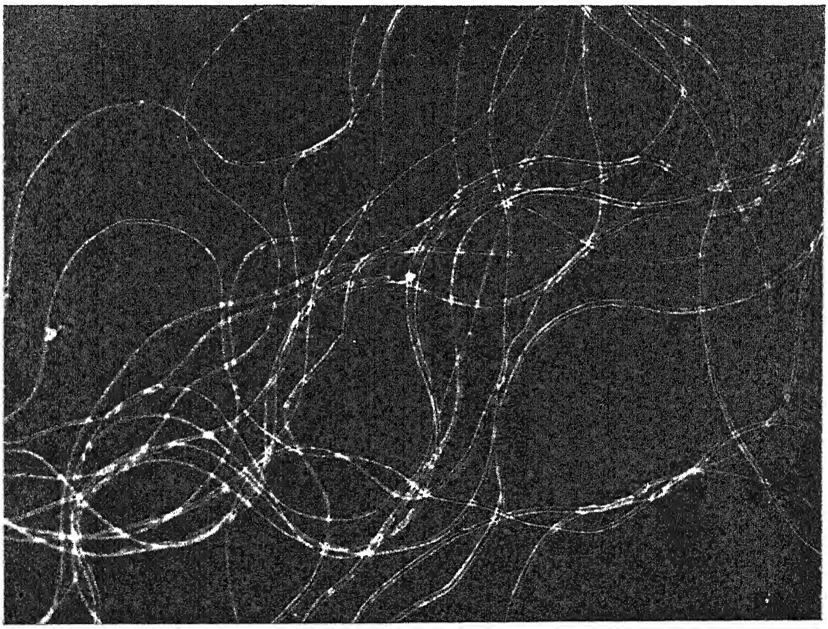


FIG. 72.—Würtenberg improved land-sheep.

PLATE XXII.

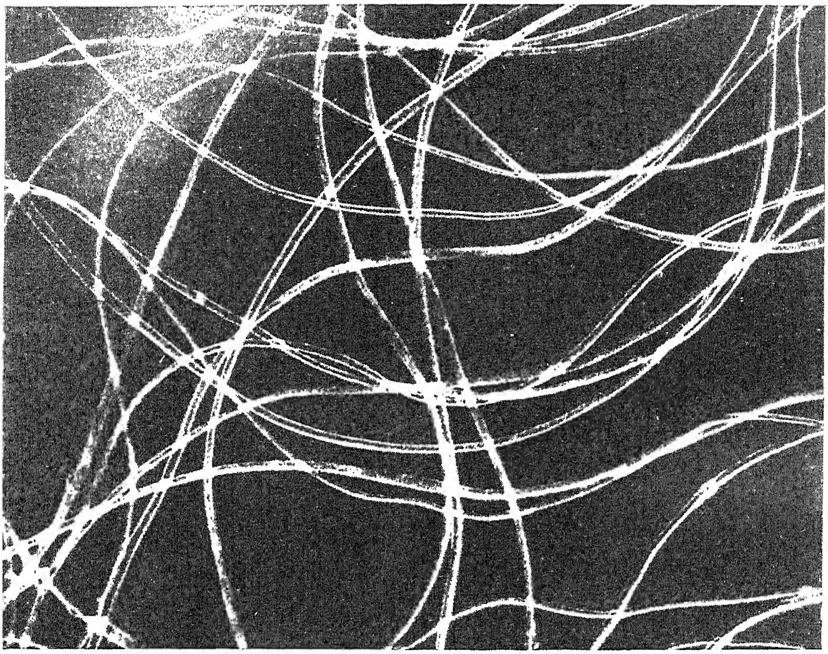


FIG. 73. — East Frisian milk sheep.

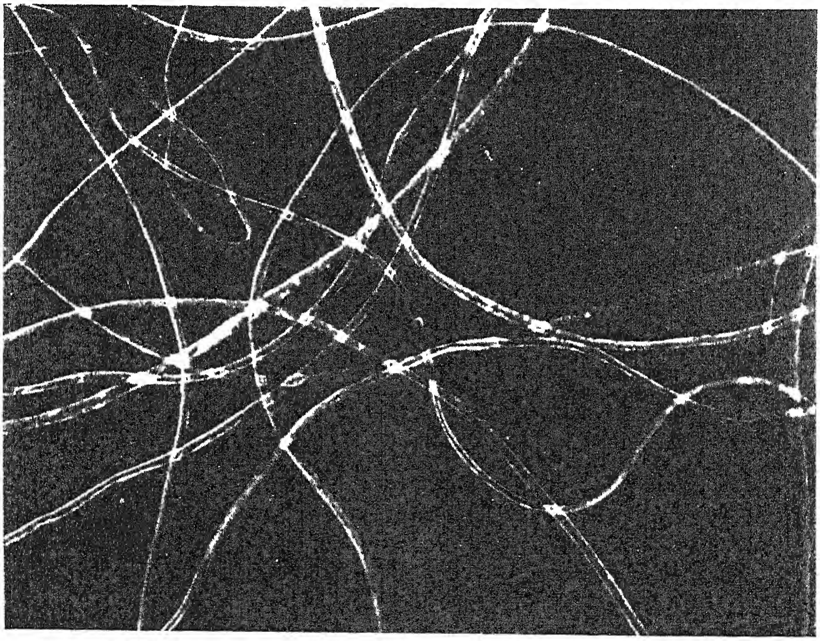
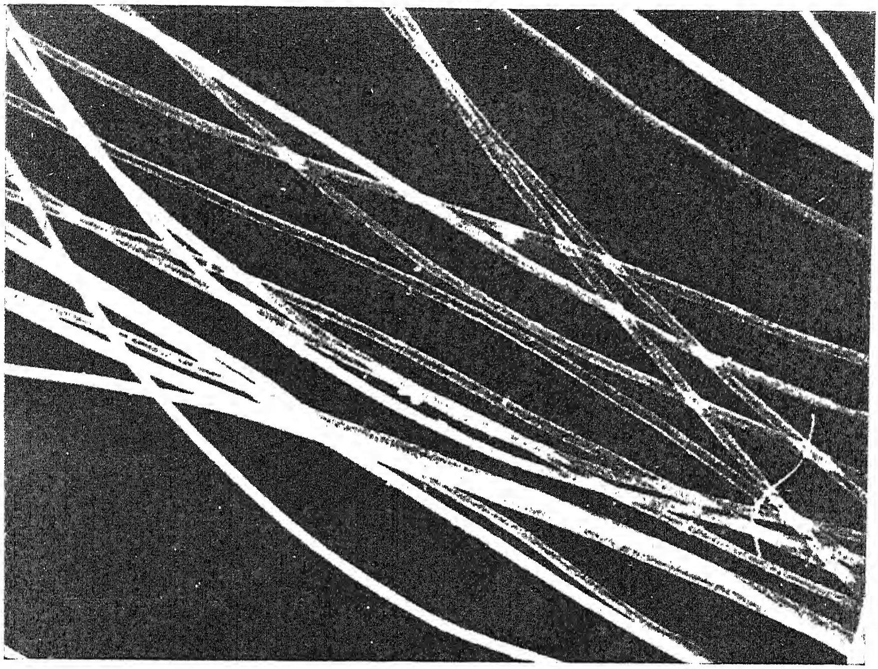


FIG. 74. — Oxfordshire

Plate XXIII.



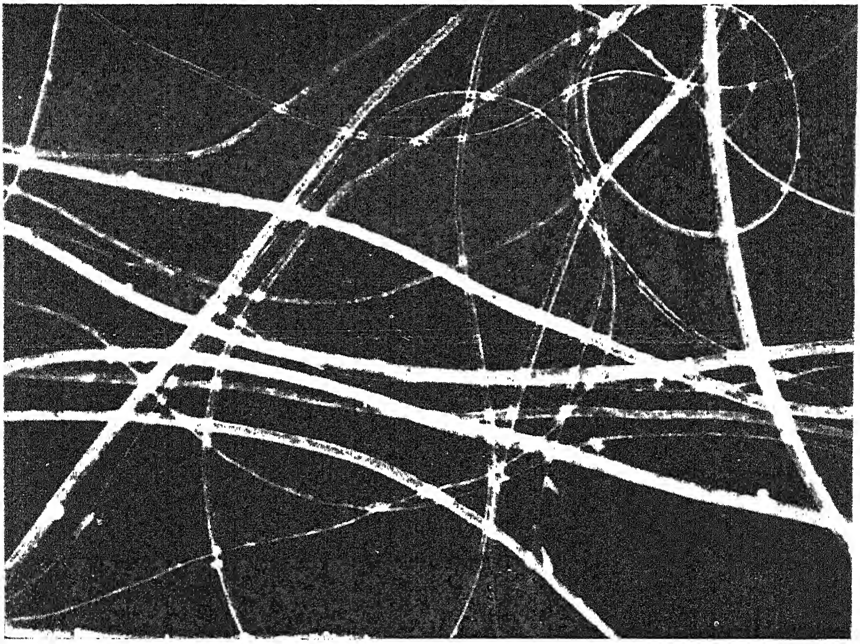


Plate XXIV.

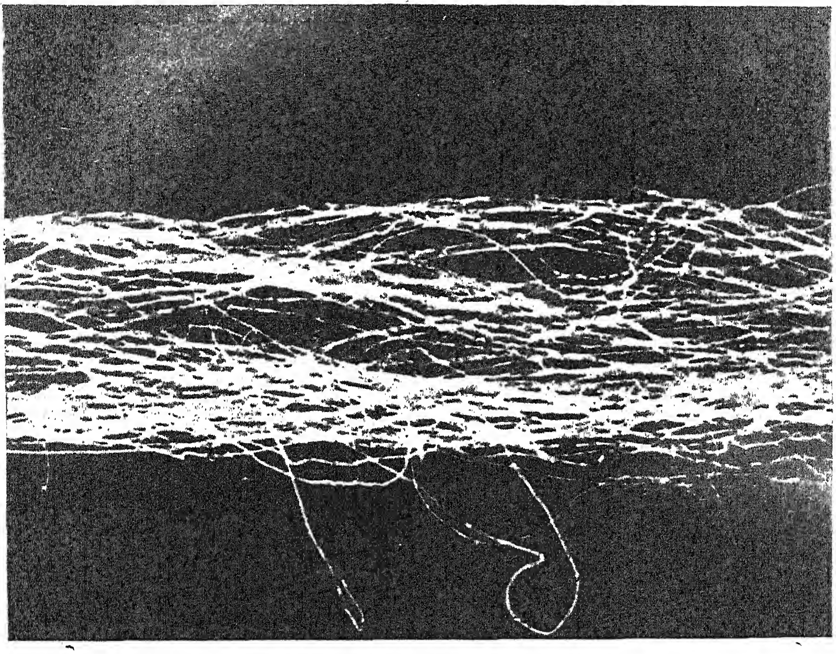


Fig. 79. — Cotton yarn.

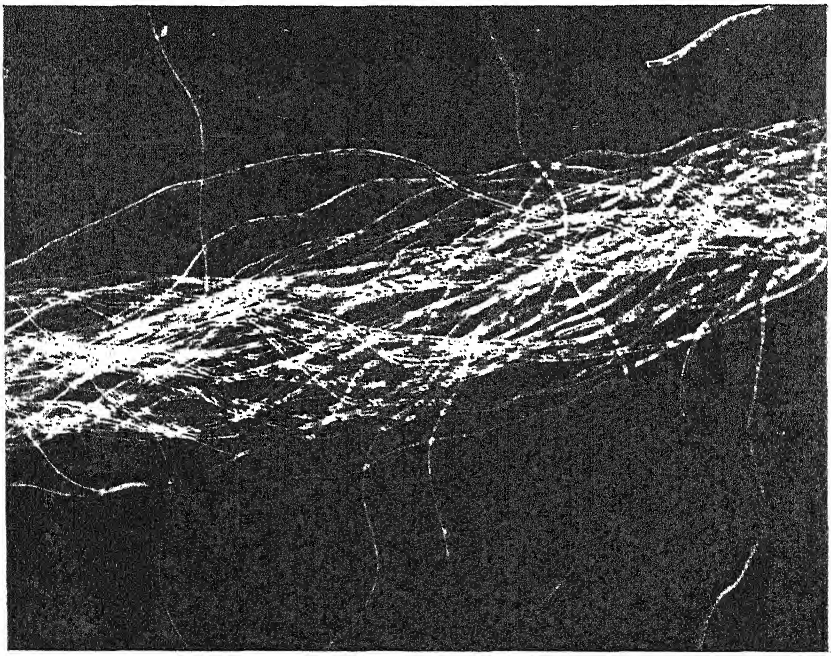


Fig. 78. — 1/30 Wool yarn.

sortments, but the fibres will be distributed amongst various classes of thickness. It is then the business of the examiner to find *between* which assortment classes the sample lies with reference to its quality or to which class belong the fibres, which constitute the *greatest part* of the sample. The carrying out of this work may perhaps at first appear rather difficult, but in reality it is not so after a little practice. Everyone who has once seen such a projected wool picture will be astonished how clearly and plainly the wool fibres stand out and how, at the first impression of the picture, the first glance gives great clearness with regard to the composition of the thickness of the fibres, and particularly as to the quality of the sample of wool.

Now, as regards the *examination of yarns* in the apparatus, this can be very valuable in practice. The yarns, as already described, are dealt with according to numbers (relation between length and weight at a definite moisture content). In these number data, however, there is, of course, no direct information available regarding the thickness of fibres, of which the material concerned is composed. One and the same yarn number, therefore, will often turn out differently, according to the delivery. Even if the difference ranges within certain limits, it may have an injurious influence on the process of manufacture. If, therefore, the sample of yarn received from the dealer is examined only once in the apparatus, and that is easily possibile technically, then buying can be done with much greater safety than without previous examination. Spinning mills, felt factories, etc., will often find it necessary to take specimens of their material for examination, in order to expose difficulties in the process of manufacture. Further, of course, all other threads, of vegetable or animal origin (cotton, hemp, silk, artificial silk, etc.), can be examined in the apparatus.

It can be seen, therefore, that the *range of applicability of the Munich examination method* is not confined to the field of wool examination, but also goes further into the process of manufacture. Once the method has proved itself serviceable in practice, then one could at last set about establishing an international unitary valuation table especially for wool, for which the results given by the projection method of examination would serve as a basis. Then, at least to a certain degree, a check would be given to speculation in the *wool trade*, and to much more of the present vagueness. This, however, presupposes of course an *understanding between the agriculturists interested in wool, and commercial and industrial interests*. The initiative

must naturally come from agriculture, because industry has perhaps less interest in such reforms.

From what has been said, it is now necessary, in order to make the advantages of the Munich method accessible to the breeders and industry of the whole world, that a standardisation of wool should be carried out in such a way as to have international validity. For this it is necessary that the qualities of wool chiefly available in the principal producing countries should be compared with one another, and from this the principal standard marks of the world be found or established. For carrying out the standardisation, of course, the experience of commerce and industry, in addition to that of agriculture, must be drawn upon; for example, there must be considered the principal qualities of wool of the largest wool dealing centres, such as England (London), Australia (Sidney, Brisbane), Cape Colony, South Africa, the Argentine, etc., as also the large spinning mills, and the wool-working and wool-growing countries. The United States of America have already established accurate standard marks, and work in accordance with these in their breeding. In Germany the matter has reached the stage where the *Sonderausschuss für Schafleistungsprüfungen der Deutschen Landwirtschafts-Gesellschaft* (Committee for testing sheep produce of the German Agricultural Assoc.) has recently decided to undertake the work of establishing, in as short a time as possible, a German wool standard, in which the Munich method will be taken into consideration.

The apparatus is at present erected in the laboratory. Negotiations are in progress, however, to make the whole apparatus capable of being taken to pieces so as to be easy for transport and manipulation, and cheap, in short, so to fashion it that there will be practically nothing to hinder its general use. Also the putting of standard pictures directly in the field of vision of the wool sample to be examined is provided for, which will ensure an easy comparison. Naturally, however, it is necessary to carry out first the standardisation of the wools of individual countries.

Nevertheless, I think I have pointed out the way by which, through carrying out the definite establishment of wool statistics throughout the world, there will also be obtained, at any rate in course of time, a classification of wool which will be as accurate as possible, and by which an objective standardisation of wool, of international validity, can be achieved.

AUTHOR'S NOTE.

A long interval has elapsed between the writing and the printing of the above treatise. During this time the Munich method has had to undergo the strongest possible criticism from which it has emerged satisfactorily.

Pronouncements on the usefulness of the method have brought matters so far as to allow the introduction of further improvements of the essential points of which I will here make mention.

For this new apparatus, the Munich method of measuring wool fibrès, a magnification of 500 was finally decided on. This magnification was reached by DOEHNER by means of ocular and objective glasses. The combined system is carried out in a tube in front of the « Cüvette ». The ocular glass is specially made for micro-projection and is perfectly corrected. Errors in projection pictures are thereby quite eliminated. The « Cüvette » has also been entirely simplified. It now consists only of 2 glass plates of which one is 2 mm., the other ½ mm. thick. Both run in a metal guide to whose lower end is fastened a container. This is fixed for the reception of the thinned cedar oil. The wool is now simply put between the two glass plates after these have been moistened with cedar oil and then pushed with them into the guide. The metal container, of which we spoke before, is brought to the lower end and partially filled with oil, so preventing a downward escape of the oil from the plates.

The fact that the object and the objective are only separated by a thin glass film of 0.5 mm. ensures a greater clearness than formerly.

The apparatus itself is made by the firm of REICHERT at VIENNA and can be got through Messers LAUTENSCHLAGER — LINDWURMSTRASSE — MUNICH.

The price of the finished product amounts to about 400 marks. (price at time of writing).

The manipulation of the whole apparatus is wonderfully simplified in recognition of the essentially practical use of the instrument.

The arc lamp is replaced by an electric glow lamp and the whole system is made light proof from without, so that daylight examination can now be made.

The whole apparatus is so packed on delivery that one can

take it about with one when travelling. The examination is no longer confined to a special Institute but can be made anywhere one may chance to be, e. g., in the stables, out on the fields, etc.

Exposures can now easily be taken on plates (for the making of prints) and also as was formerly the case on gas light paper.

Dr. H. Henseler,
Professor and Director of the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich.

N. B. — Professor Henseler has just been asked to study the wool problem by the Australian Government.

THE USE OF SULPHURIC ACID AGAINST WEEDS AND CERTAIN CROP PARASITES

Since 1907 we have been investigating the use of dilute sulphuric acid for the destruction of weeds and various parasites of cultivated plants.

I. — Use of sulphuric acid in fields of cereals.

Utility of the treatment against weeds.

The utility of the treatment against weeds does not require lengthy demonstration. Good agriculturists admit that, on many properties, weeds cause greater losses than frost, hail and parasites. Particularly, deficient crops of cereals are due in great measure to the intense growth of adventitious plants favoured by prolonged periods of rain. This situation draws greater attention to various processes of cleaning lands sown with corn, hoeing of wheat fields, repeated harrowing to pull up certain superficially rooted plants. These operations are not always applicable or effective owing to the want of manual labour or to excessive humidity of the soil. Consequently quicker and less costly methods, such as applications of liquids or caustic powders, have been welcomed.

Agriculturists have especially made use of spraying with 1000 litres per hectare of a 4 per cent. solution of sulphate of copper, or again powder spraying with 300 kilogrs. of anhydrous sulphate of iron. Dilute sulphuric acid has also been recommended. The first trials of sulphuric acid on fields of cereals date back to 1898. Messrs. Bonnet, Brandin and Duclos, who experimented with this product in the Paris district, then concluded that it could not be used in practice.

We have renewed these trials and, by degrees, we have been able to determine the periods of use, the doses of the acid and the precautions to observe. On the whole the results on cereals (wheat, rye, barley and oats) are very satisfactory. Growers now use se-

veral thousands of trucks of acid and some twenty makers manufacture special spraying machines for the application of this new cultural practice.

At dilutions of 5 to 15 per cent. in volume, sulphuric acid is much more active than sulphate of iron, sulphate of copper, sylvinit or sea salt, with which many weeds are not destroyed. It does *not* cause a partial poisoning of the cereal and a decrease of growth of straw as do copper salts or chlorate of soda and its derivitives. Applied in numerous fields, where it would be serviceable, the process of destruction of weeds which we have investigated, properly used and popularized, could increase the crops of wheat in France by several million quintals.

Action on soils. — Sulphuric acid attacks the mineral or organic matter in soil (very rapidly).

It forms sulphates which, in dry weather, appear as a white powder, recalling that obtained after an application of superphosphate. The action of dilute sulphuric acid on minerals, organic matter and bacteria in the soils has not yet been determined. Fertilisation by acid solutions is always shewn by an increased crop. This fertilising action is also very marked on various crops following immediately the cereal treated, such as turnips and red clover.

However, in a dry soil, the treatment followed by a long dry period may decrease the yield, so that early sprayings are preferable for light soils and in warm regions.

Sulphuric acid is decalcifying in the same degree as sulphate of ammonia and it decomposes a weight of lime approximately equal to its own weight.

Action on weeds — Sulphuric acid is not poisonous; it is a dehydrating substance. It acts more strongly when the organs acted on are younger, more tender, more swollen with water. Similarly the action is more decided and quicker when the evaporation of the acid solution is more rapid owing to a dry, warm, windy, sunny atmosphere.

With 8 or 10 per cent. solutions of acid at 65° Baumé, many weeds are quickly scorched, viz. those which when young have widespread, soft leaves easily wetted, with terminal buds easily visible at the surface of the soil, for example :—

Ranunculus arvensis
Sinapis arvensis
Raphanus Raphanistrum

Matricaria inodora and *M. Chamomilla*
Polygonum aviculare
Medicago apiculata.

Other weeds, more resistant, are destroyed with a strength of 12 to 14 per cent. by volume of acid at 65° Baumé, of 1820 density :—

Papaver Rhoeas
Scandix Pecten-Veneris
Centaurea Cyanus
Borago officinalis
Lychnis Githago
Vicia, *Lathyrus*, etc.

The action is, moreover, more marked when younger plants are operated on, subject to the condition, however, that they are above ground and quite visible.

The leaves of thistles (*Cirsium arvense*) arranged in a rosette, are badly scorched and the corrosive action even just reaches the underground stem. Under these conditions, instead of producing three or four shoots, as occurs after cutting thistles, the weed puts up, very late, a single thin stem which does not flower and at harvest time scarcely exceeds half the height of the stalks of the cereals.

Unfortunately, all weeds are not killed, and among those which resist the treatment, should be mentioned the bulbous Liliaceae (*Muscari*, *Allium*, etc.) as well as various harmful Gramineae :— *Agropyrum repens*, *Agrostis stolonifera alba*, *Arrhenatherum bulbosum*, *Lolium temulentum*, *Avena fatua*.

Action on the cereals. — The cereals are much more resistent to dilute sulphuric acid than most of the weeds and this essential difference explains the results obtained.

In spite of the sorry appearance which immediately follows the application, too much concern should not be shown, nor a hasty conclusion reached. As a matter of fact, cereals with their smooth erect leaves covered with cutin and with their ears hidden in the centre of a sheath, suffer little from the treatment.

The roots, remaining intact, soon repair the damage caused by a kind of nipping. The acid may scorch and whiten two or three of the five or six outer leaves which each cereal plant has at the time of treatment. But, after a fortnight or so, the

plant starts again vigorous, strong and green; it produces strong stalks and full ears. The maturity of cereals treated with the acid is retarded by a few days and the straw lengthens in the fortnight which precedes harvest. The delay in the upward growth of the wheat decreases lodging. When the treatment is effected early enough, the crop of straw is in no way modified. On the other hand treatment effected too late reduces the height of the stalks.

In the week following the treatment, scatter nitrate and harrow. The fertiliser will produce its full effect on the crop.

Thanks to the treatment, the grains are more abundant, and larger, without mixture of weed seeds, which further increases the selling value of the crop. Moreover, by preventing the weeds from seeding, treatments repeated for several years contribute in a most efficient manner to the permanent cleaning of the soil.

Treatment with acid is easier, quicker and less costly than hoeing cereals; it acts both on the rows and in between them.

Action on Footrot of Wheat. — Our observations in experimental plots and also in treatment of large crops which deal with thousands of hectares of wheat yearly, have enabled us to note, since 1913, a very marked efficiency of sulphuric acid against Footrot of wheat at least as regards treatment with a strength of 10, 12, or 14 per cent. of acid at 65° Baumé on winter wheats bearing five or six leaves.

In certain cases the difference between the plots was extremely striking. The control plot had numerous stalks bent at the base, almost severed by rot, while on the treated surface it required a long search to find, at the feet of culms remaining erect, a few superficial black spots of *Leptosphaeria herpotrichoides*.

Numerous concordant results obtained in Gascony, Brittany, in the Beauce, etc. confirm this useful effect of the sulphuric acid treatment against the Footrot lodging caused by *Leptosphaeria*. The treatment appears to be equally effective against "Take all" or "White head" Footrot caused by *Ophiobolus graminis* which rots the collar region of the plant.

For the last four years, at the National School of Agriculture at Rennes, all wheats after potatoes, more particularly exposed to attacks of Footrot, are treated with the acid in the second half of March, even in the absence of weeds.

Nature of the acid. — The factories supply acid at 65° Baumé, acid at 60° or acid at 52-53°. These three types of acid may suit.

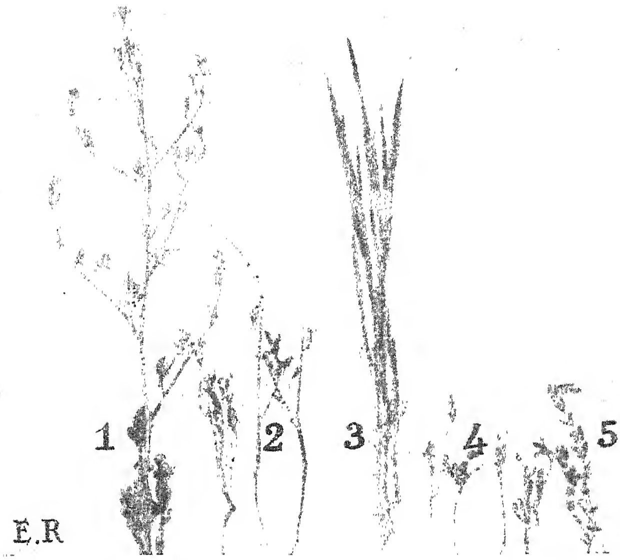


FIG. 80. — Effect of sulphuric acid at a strength of 10 per cent by volume on some plants. (Photograph of 15th April 1912).

(1) Untreated charlock.

(2) Charlock treated on the 5th March; the principal stalk has been scorched.

(3) Wheat plant treated on the 10th February ; the plant has not suffered.

(4) Charlock treated on the 10th February and remaining short, stunted and deformed.

(5) *Lathyrus Aphaca*, treated on the 10th February : the stalk, scorched, has not elongated.

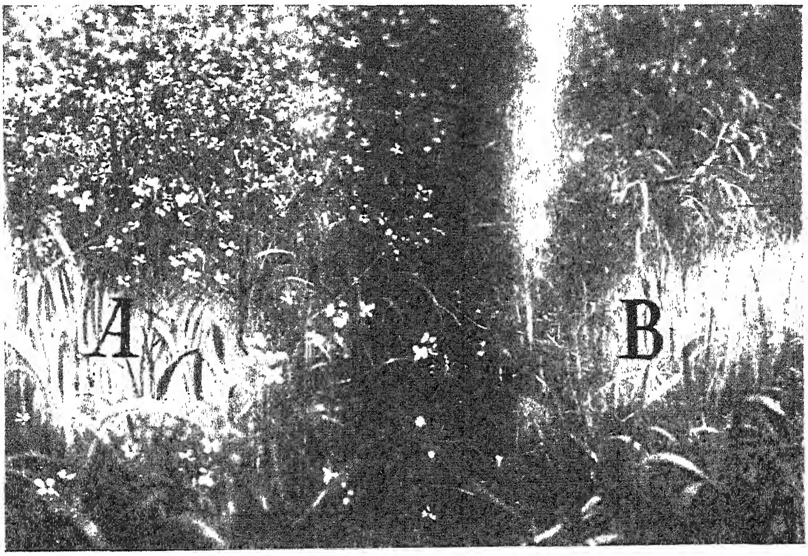


FIG. 81. — Field of wheat infested with white charlock (*Raphanus Raphanistrum*), treated on the 5th March 1912 whith sulphuric acid at a strength of 10 per cent by volume. Photograph taken on the 15th April 1912.

A. Control plot, with charlock.

FIG. 82. — *Action of sulphuric acid on Foot rot (Leptosphoeria).*
Treatment of February 1913 with 1000 litres per hectare of solution at a strength of 10 per cent. of acid at 65° B.
Just before reaping, the stalks are bent and lodged in the control part ; they are erect with large ears, in the treated part.

FIG. 83. — *Action of sulphuric acid on Footrot of wheat.*
Result of a treatment in March 1924, in Beauce, with 1200 litres per hectare of 12 per cent solution by volume of acid at 65° B.
In the foreground, control plot with the stalks lodged.
In the background, treated plot with erect stalks.

The acid at 52° is often the easiest to procure and the most profitable. It is the easiest to handle.

The normal acid at 65-66° B. is slightly more expensive than the other commercial types; but it is pure; it saves packing in carboys and diminishes the cost of transport. The type to be preferred is that which is cheapest per kilo of pure acid; at short distances from the factories this will often be the acid at 52-53° Baumé. 1 litre of acid at 65° is equivalent to 1.25 of acid at 60° or 1.50 of acid at 52°.

Acid strength and quantities of solution. — For winter cereals, the average strength is 10 litres of acid at 65° Baumé per 100 litres of prepared solution the density of which reaches 1100-1110. 1000 to 1200 litres of this solution must be sprayed per hectare of cereals in order to wet them as would a heavy dew.

We have always insisted on the utility of a *preliminary test* which allows us to determine in a few days the suitable strength:— 7, 10, 12, 14 per cent. for winter cereals, according to the kind of weeds to be destroyed and according to the state of the crop.

With oats and spring barley, to be treated for preference when they have two or three leaves in the second half of April in Central France, one gets complete destruction of charlocks or mustards by spraying, on fields rolled and levelled using a sulphuric solution of 1040 to 1045 density; obtained with 4 to 4 ½ litres of acid at 65° or 7 to 8 litres of acid at 52°-53°.

Sulphuric solutions of 1040 to 1045 density do not cause noticeable injury to clovers and lucerne sown in spring in the cereals.

Period of treatment. — Ordinarily, at the time of treatment, the winter wheats, ryes or oats have leaves 10 to 12 centimetres long, to the number of 5 or 6 leaves per plant. The bud is still well buried, but the leaves are already covered with the waxy coating which renders them difficult to wet and very resistant. The soil is still very visible and the weeds to be destroyed have only two or three slightly developed leaves, not hidden under the leaves of the wheat. It is mainly the appearance of the weeds to be destroyed which determines the period of treatment, which must be *in dry weather*, or at least not rainy.

In France, in the South-West, the winter treatments are graduated from the 15th December to the 15th March. In the Centre, the period 1st to 15th April is preferred.

Spring cereals are mainly treated when they have three leaves,

in the second half of April, in France, as soon as the weeds to be scorched are well spread on the ground, without being covered by the cereals.

Preparation of solutions. — The use of a densimeter, for example the mustimeter or must hydrometer graduated from 1000 to 1200 is of real service in the preparation and checking of sulphuric solutions.

In the cultural practice which concerns us, the difference of density due to the rise in temperature, from about 10° to 30° C., is negligible.

The strength of 10 per cent. of acid at 65°, used on winter cereals, corresponds to the density of 1100 to 1110 or 13° Baumé, and all solutions of that density contain the same quantity of pure acid, whatever the commercial acid may be (at 65°, or at 60° or at 53°), which was used in preparing them.

For spring cereals the average strength of 4 per cent. corresponds with a density of 1045 (or 6° Baumé). Consequently it is possible and advantageous to prepare in this way 200 litres of solution :

1) Into a barrel open at one end pour about 150 litres of water ;

2) Add gradually approximately, without weighing or measuring, the dose of commercial acid adopted for 200 litres of solution ;

3) Stir thoroughly with a stick or with the loading pump.

4) Check the density with the densimeter.

5) Fill up to 200 litres, by adding as required a little more acid or a little more water.

6) Stir again and verify the density, average 1100 for winter cereals and 1045 for spring cereals.

Precautions to be taken. — The concentrated acid is dangerous, but 10 per cent. solutions only attack the hands slowly ; the pain however is sharp on cuts or cracks. When the work is continued for several days, the hands are heavily greased, or leather or rubber gloves are used.

The eyes are very sensitive to the action of small drops of acid. The operator stands so that the wind blows the sprayed solution away from him or to one side.

For greater safety the eyes are protected with spectacles, but this precaution is seldom necessary.

To avoid wetting his boots, the operator holds the nozzle of the

spray away from his path. He should also wear sabots and old clothes. Woollen clothes are attacked least.

The workmen should be warned of the danger of the splashing of pure acid caused by the entrance of air into the neck of the carboys when being emptied.

The acid is always poured slowly into a large quantity of water. To prevent dangerous splashing the water should never be poured into the acid. The mixture of acid and water becomes warm. The use of warm solutions, recently prepared, gives more marked results, but the joints or solderings of the apparatus are more corroded.

It is as well to put some pure water near the field, to enable immediate and thorough washing to be done in case of accident.

Results on cereals. — (1) When *winter cereals* have 5 or 6 leaves, from December to mid-April, in the Northern hemisphere, *make a preliminary trial*, then destroy the weeds with solutions containing 8 to 12 litres of sulphuric acid at 65° B. per 100 litres, or an equivalent quantity of sulphuric acid giving a density of about 1100.

(2) For *spring cereals*, when they have 2 or 3 leaves, about a month after sowing, and when the weeds to be scorched are well out, make a preliminary trial and treat with a solution containing 4 or 5 litres of acid at 65° B. per 100 litres, or an equivalent quantity of sulphuric acid giving a solution with density of about 1045.

(3) With an apparatus on wheels it is possible to treat a hectare in two hours at a total cost of less than 100 francs, labour included.

For wheat, the average increase of crops in fields treated varies from 200 to 500 kgs. of grain (per hectare): it is *often much more* and is well worth the cost.

II. — USE OF SULPHURIC ACID ON VARIOUS CROPS.

Without reviewing the various agricultural uses of sulphuric acid, we shall here note its utilization in fields of flax, lucerne and permanent grasslands, for control of Vine Antracnose and for the winter cleaning of fruit trees.

Destruction of weeds in flax fields. — Flax fields with plants 15 centimetres high very much infested with thistles (*Cirsium arvense*), white charlock (*Raphanus Raphanistrum*), sow-thistle (*Sonchus*), were

treated towards the 15th May with 1200 litres per hectare of a solution of sulphuric acid of 10 per cent. strength by volume.

Five days after treatment most of the weeds were completely withered. The stalks of flax, on the other hand, had retained their beautiful green colour and gave a high yield. Flax therefore seems to show at least equal resistance to sulphuric acid as do grasses (G. JANNIN, 1925). A great advance would be made if this expensively weeded crop could be, by means of treatment with acid, sufficiently freed from weeds to enable the harvesting to be done with a reaper-binder.

Use in lucerne fields and grass lands. — In January we treated lucerne fields and permanent grass lands with solutions of sulphuric acid at strengths of 10 per cent. and 15 per cent. by volume.

The slugs (*Limax agrestis*) were killed, blackened and eliminated in 24 hours. The moss, discoloured, yellowish-white, was easily pulled up.

The sow-thistles (*Sonchus*), dead-nettles (*Lamium*), crepis (*Crepis*), the Ribwort plantain (*Plantago lanceolata*) had disappeared. The destruction of the crepis and the plantains is of real importance.

The lucerne shoots, 2 cm. long, were scorched with consequent retarded growth in January and February. But by the 20th March the treated lucerne was as fine as the untreated. Tests are to be renewed at an earlier date and with various strengths.

Destruction of dodder. — In the month of August we sprayed patches of dodder in a lucerne field with a solution of sulphuric acid at a strength of 8 per cent. by volume. The filaments of the parasite immediately became darker in colour, golden yellow, and then soft, sticky and withered.

The lucerne wetted by the solution was completely whitened. But the buds of the collet, slightly underground, were not scorched. After a fortnight, the tufts which were not too much exhausted by the successive action of the dodder and the acid began to grow again, without the dodder.

The result, however, is rarely complete, for it is necessary to soak all the filaments of the parasite without exception, otherwise fresh patches appear, either by the growth of the surviving filaments or by the germination of fresh seeds. The results are improved by cutting first of all the patches of dodder for 0.50 m. beyond the outermost filaments, removing the cut stems in a cloth, and then watering with an 8 per cent. solution of the acid.

Washes against Vine Anthracnose. — The use of acid solutions in vine growing has been known for a long time.

This process, however, did not become general until about 1910. For a long time, washing with solutions of sulphate of iron at a strength of 30 per cent. with 2 litres of sulphuric acid added to it, was used against Vine Anthracnose.

Now, vine-dressers give preference to simple solutions of sulphuric acid, prepared by pouring 5 or 6 litres of acid into 100 litres of water.

The solution is applied, either with a brush or with a leaden sprayer, in the month of March twenty days before the swelling of the young shoots. We have noted that the start of growth is retarded by ten to fifteen days, which to that extent decreases the risk of white frosts.

The bark disintegrates and falls, especially after two or three years of treatment. This cleansing does away with the winter resting places selected by *Sparganothis pilleriana, Conchylis ambiguella* and *Polychrosis botrana.*

Winter cleaning of fruit trees. — A solution of acid at a strength of 5 per cent. by volume was sprayed in January by means of long nozzles on the trunks and branches of various fruit trees.

The lichens and moss were reduced to the state of a grey, granular powder which is very quickly detached, leaving the bark smooth and bare.

The acid also destroys *Protococcus viridis,* an alga of small round cells which covers the trunks of trees with a greenish coat, particularly on the side exposed to rain.

Many germs of parasites (*Monilia cinerea, Puccinia Pruni*) may thus be destroyed by sulphuric acid. Perhaps this is also the case with the eggs of certain insects, such as *Cheimatobia brumata.*

On the other hand, the external tissues of the bark even on fairly old branches remain green for a long time, full of chlorophyl. It is permissible to think that this chlorophyl intervenes in the nutrition of the tree, subject however to the condition that the sun's rays can reach it, without being intercepted by a screen of lichens. With two or three litres of acid solutions, a tall fruit tree of medium size can be thoroughly wetted in winter by means of a sprayer. In our experiments the buds of cherry trees, pear trees and plum trees have in no way suffered from treatment at a strength

of 5 per cent. of acid by volume and flowering took place under good conditions.

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To sum up, sprayings with dilute sulphuric acid act as fertilisers of the soil, as destroyers of many weeds, and of many crop parasites, notably the fungus which causes Footrot of Wheat.

The list of the uses of sulphuric acid in agriculture is not completed, and various methods of application may be considered. Thus we have found a stronger weed-killing action and a more marked fertilising action by the addition of sulphate of ammonia to the sulphuric acid solution. Nitrate of soda acts similarly. Liquid fertilisers, to be used in small quantities, are at the same time distributed with an evenness difficult to obtain otherwise.

In Italy, at Perugia, MORETTINI brought to notice, between 1913 and 1915 the good effects of the sulphuric acid treatment on wheat, and the late savant GIGLIOLI, of the University of Pisa shewed the excellent results obtained by the use of sulphuric acid diluted with fresh urine (1916).

French manufacturers have studied simple strong apparatus made with materials which stand dilute acid well (wood, rubber, lead, special bronzes) and which allow of a good spraying of 800 to 1500 litres or more of solution per hectare being made in a single transit. The contents of the barrels varies according to the average length of the fields in each region, so as to avoid both too frequent replenishments and the too prolonged transport of an excessive load.

According to circumstances, the pump compresses the air in the barrel above the acid solution, or else it forces the solution itself into the compression chamber.

In France, for the past twenty years, the use of sulphuric acid in fields of cereals has been popularized by the Agricultural Services and Associations, Agricultural officials, manufacturers of apparatus and spraying contractors. In the Department of Seine-et-Oise Syndicates have been formed for the control of crop pests, and their usual procedure is a methodical organisation of sprayings with sulphuric acid.

Elsewhere, Syndicates for a common stock of machines or Municipalities have purchased a sprayer on wheels, which is used

for the spraying of acid solutions for the treatment of vines and potatoes with Bordeaux mixture and for weed killing in streets and pavements with a 2 per cent. solution of chlorate of soda.

The method which we recommend has also been applied with success in Italy, Algeria, Australia, Belgium, England, the Argentine Republic, etc.

We should be glad if the publication of these few results in the *Review* of the International Institute of Agriculture encouraged inquirers in various countries to adapt the methods of application of dilute sulphuric acid to local conditions of agriculture.

Moreover, the questions here raised could form the object of methodical research in the special Stations which, besides documentation and propaganda work, prosecute researches on the biology of weeds and on the various processes of control cultural, mechanical, physical and chemical.

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INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

THE EFFECT OF LIME AND FERTILISERS ON THE POTASH CONTENT OF SOIL AND CROP.

During the past 25 or 30 years many thousands of soil and crop samples have been analysed by the various experiment stations in the United States. Many of these analyses have been published in bulletins, books and journals. In some cases authors have compiled analyses from various sources, including work done in foreign countries. Probably in the majority of cases no record has been made of the type of soil, or of the fertiliser treatment that was given to the particular crop from which the sample was taken. It is well known, however, that the composition of the crop may be distinctly influenced by the fertiliser treatment, and since it has become quite customary to calculate the amount of plant food removed by a given crop by reference to such tables of analyses, the importance of having reliable information with regard to the soil type and fertiliser treatment is at once apparent. Otherwise the value of such calculations may well be called in question.

If, for example, the dry stalks of corn (maize) grown under one condition show on analysis 1 per cent of potash and under different conditions 3 per cent of potash, how can one fairly calculate the amount of potash removed by one ton of the stalks grown under average conditions without knowing which sample most nearly represents this average condition? In the one case a ton of the stalks would remove 20 pounds of potash and in the other 60 pounds.

In studying the analyses of crops from the nitrogen availability experiments at the New Jersey Experiment Station, it became evident that in many cases the compositions of the crop had been dis-

tinctly influenced by the fertiliser or lime treatment. Since these experiments have established conditions which are especially favourable for such a study, it seems well to record some of the results obtained from field experiments which have been in progress since 1908.

PLAN OF EXPERIMENT.

In connection with the nitrogen availability work, 40 one-twentieth acre plots have received definite fertiliser treatments annually. Twenty of these have been limed (carbonate) at intervals of five years, and 20 have received no lime treatment during the period. Some of the plots have received no fertiliser, some have received one ingredient only, some two, others two plus farm manure, and still others three of the common fertiliser ingredients both with and without manure.

The soil is a loam of fair quality, which had not been farmed for some years preceding the starting of this work in 1908.

With the completion of 15 years work, which includes the crop of 1922, samples of soil were taken from these plots (1) and their potash content was determined. Potash has also been determined in the corn stalks taken from these plots in 1923, and in samples of some other crops from these plots as indicated in table 2.

POTASH IN SOILS.

Table 1 shows the fertiliser and lime treatments that these plots have received and also the percentage of potash in the soil and in the corresponding crop. An examination of the figures for the soils shows that in nearly every case the percentage of potash is lower in samples from the limed than from the unlimed series, the average for the limed plots being 1.088 per cent and for the unlimed 1.268 per cent. The differences noted here can hardly be due to accident but must be attributed to the differences in treatment. The lower percentage of potash on the limed series is undoubtedly due, in part at least to the exchange of bases, the lime of the applied limestone taking the place of the potash in the soil. Since the crops on the majority of these limed plots have been only slightly larger than those on the unlimed series, the difference could hardly be attributed to the greater utilization of potash on the limed series.

(1) Samples taken to the depth of about 6 $^2/_3$ inches.

TABLE I. — *Potash (K_2O) in soils and in corn stalks from corresponding unlimed and limed plots, with different fertiliser treatments.*

Plot No.	Fertiliser treatment (per acre)	K_2O in soils-1922		K_2O in corn stalks 1923			
		Unlimed (A)	Limed (B)	Unlimed (A)		Limed (B)	
		per cent	per cent	per cent	lbs per acre	per cent	lbs per acre
1	Nothing	1.364	1.038	0.779	14.49	0.604	14.13
2	320 lbs muriate of potash	1.371	1.030	2.177	43.98	1.838	48.52
3	640 lbs acid phosphate	1.464	0.984	1.406	28.12	0.426	10.99
4	Minerals *) only	1.426	1.031	2.346	59.12	1.834	67.86
5	» + 16 tons cow manure	1.186	0.953	2.872	83.29	2.246	83.10
6	» + 16 tons horse manure	1.395	1.228	3.200	94.72	2.636	106.49
7	Nothing	0.742	1.085	0.593	5.04	0.618	17.92
8	Minerals + 160 lbs. $NaNO_3$	1.310	1.186	2.784	75.17	2.345	81.14
9	» + 320 » $NaNO_3$	1.267	1.015	3.185	87.27	2.014	66.86
10	» + $Ca(NO_3)_2$ **)	1.353	1.046	3.181	87.16	1.832	67.05
11	» + $(NH_4)_2SO_4$ **)	1.189	1.038	2.278	19.14	1.949	61.98
12	» + $CaCn_2$ **)	1.216	1.104	3.208	102.01	2.090	68.55
13	» + Blood **)	1.453	1.036	1.960	62.72	1.968	62.98
14	» + Ground fish **)	1.650	1.100	2.172	58.21	2.175	73.52
15	» + Tankage **)	1.034	0.938	1.997	64.30	2.478	98.62
16	» + 2 tons alfalfa hay	1.062	1.050	2.549	68.31	1.831	49.07
17	» + 2 tons rye straw	1.445	1.356	2.488	68.67	2.435	90.58
18	» + Cow manure + 320 lbs. $NaNO_3$	1.085	1.228	2.832	104.22	2.218	85.17
19	» Only	1.135	1.093	2.674	82.89	2.794	89.97
20	» + Rye straw + 320 lbs. $NaNO_3$	1.216	1.220	2.185	62.05	3.103	98.68
	Average	1.268	1.088	2.343	63.54	1.972	67.16

*) Minerals = 640 lbs. acid phosphate and 320 lbs. muriate of potash per acre.
**) Equivalent to 320 pounds $NaNO_3$ per acre.

On the other hand there are differences within the series which are probably due to inequalities in the soil or to errors in sampling, or both. That these differences within the series are not due to the potash treatment is shown by comparing the results from plots 2 and 3 unlimed (A's) with 2 and 3 limed (B's). Plots 2 A and 2 B have received annual applications of muriate of potash equivalent to 320 pounds per acre for about 15 years, whereas plots 3 A and 3 B have received no potash fertiliser during this period. It will be noted, however, that in the case of 2 A and 3 A the difference in potash content is easily within the limits of experimental error ; the same may be said of 2 B and 3 B. To take another example, plot 4 B receives the annual application of muriate of potash and plot 5 A receives the same plus an annual application of manure, which adds about as much potash as the muriate (160 pounds per acre), but on analysis 5 A shows a lower percentage of potash than 4 A. In this case the difference may be due, in part at least, to the fact that 5 A has always yielded larger crops than 4 A, as shown by the total potash removed.

In case of plot 7 A which receives no fertiliser it would appear that the potash content of this soil has been distinctly depleted during the 15 years, for it now contains only a little over half as much as plots 6 A and 8 A, these being the plots which touch it on either side. There are other differences which should probably be explained on the ground of a difference in location rather than differences in treatment. For example, plot 14 A contains 1.65 per cent potash and 15 A, 1.034 per cent potash, but these plots are separated from one another by two one-twentieth acre plots, and furthermore 14 A occupies a little lower ground than 15 A.

Potash was determined in certain of the subsoils (6-13 in.) with the following results :

Plot No.	Unlimed (A) per cent	Limed (B) per cent
2	1.467	1.178
3	1.569	1.383
7	1.122	1.046
14	1.530	1.399
20	1.399	1.159
Average	1.417	1.233

Potash Content of Corn Stalks.

When we study the percentage of potash in the stalks from the different plots, we find a much greater difference than was found in the soil. A comparison of the results for the two sections shows that in the majority of cases the percentage of potash is higher in samples from the unlimed than from the limed section. It will be recalled that this same relation exists between the soils of the section, but it hardly seems possible that this difference in the soils is great enough to influence the potash content of the stalks to the extent that is here noted.

Attention may be called to some of the striking differences. For example, sample 2 A contains approximately one and a half times as much potash as 3 A, and 2 B contains over three times as much as 3 B. Samples 6 A, 10 A and 12 A contain close to eight times as much potash as sample 3 B. Sample 13 A contains the same amount of potash as 13 B, and 14 A the same as 14 B ; on the other hand 15 A and 15 B differ by about .5 per cent; although they are quite close together and have received the same potash treatment. Samples 7 A and 7 B (no fertiliser) contain about .6 per cent potash while samples 6 A and 6 B, the adjoning plots respectively on the one side, and 8 A and 8B the adjoning plots respectively on the other side, contain about 2.75 per cent potash.

The lowest percentage of potash is .436, representing sample 3 B, which is equivalent to 8 ½ pounds of potash to the ton of stalks ; the highest percentage shown is 3.208 for sample 12 A, which is equivalent to 55.6 pounds of potash to the ton of stalks.

There is a considerable variation even where the potash treatment has been uniform. Samples 9 A, 10 A, and 12 A show over 3 per cent of potash, whereas sample 17 A, which receives the same amount of muriate of potash as the others shows only 2.28 per cent of potash. It is difficult to reconcile some of these differences. That it cannot be due wholly to the natural supply of potash in the soil is indicated by the fact that the soils from 16 A and 16 B contain almost exactly the same amount of potash, whereas the stalks from these two plots differ by almost .75 per cent. Neither can it be attributed to a difference in the amount of available nitrogen, for 18 A receives a large excess of available nitrogen, whereas 19 A receives

no nitrogen, but the potash content of the stalks is very nearly the same in each case.

It seems worth while to call attention to the fact that for the unlimed section the samples from the six plots which have received a basic nitrogenous fertiliser ($NaNO_3$, $Ca(NO_3)_2$ or $CaCn_2$) give an average of 2.896 per cent potash, while the samples from the five plots that have received an organic nitrogenous fertiliser give an average of 2.233 per cent potash. For the limed section the corresponding figures are 2.267 and 2.177 per cent potash. In this connection it is interesting to speculate as to whether, through an exchange of bases, soil potash was released and in turn taken up by the plant.

The average percentage of potash for all samples from the unlimed section is 2.343 per cent, and the average for all from the limed section 1.972 per cent. Here we may raise the question as to why stalks from the limed section should contain less potash than those from the unlimed section. It may be that the repeated applications of lime, having helped to reduce the potash content of the soil, particularly the more readily displaceable portion of it, discouraged excess (luxury) consumption of this ingredient. With our present knowledge a positive answer cannot be given. It may also be that on the limed section a part of the plant's basic requirement has been met by the utilization of lime to the exclusion of a part of the potash. Determinations of the lime content of the plant may throw some light on this point. Lime was determined in a limited number of samples from both the limed and unlimed sections, and without exception the percentage of lime (CaO) is higher in samples from the limed than from the unlimed section; with one exception the reverse is true of the potash. Further work should be done on this point but this gives some ground for believing that in the presence of a liberal supply of lime the plant may take less potash than where the supply of lime is limited. The comparative lime and potash figures are shown in Table 2.

Reference to the columns showing pounds of potash removed per acre by the corn stalks, makes it clear that there is a wide variation in the amount thus removed, the lowest for the unlimed series being 5.04 pounds and the highest 104.22 pounds per acre; the lowest for the limed series is 10.99 pounds and the highest 106.49 pounds per acre.

TABLE 2. — *Lime (CaO) and Potash (K_2O) in Corn Stalks from Limed and Unlimed Plots.*

Plot No.	CaO in Stalks		K_2O in Stalks	
	Unlimed per cent	Limed per cent	Unlimed per cent	Limed per cent
3	0.823	0.885	1.406	0.426
10	0.660	0.881	3.181	1.832
21 * and 22	0.694	0.918	2.112	1.362
35 * » 38	0.751	0.800	2.897	3.210
42 * » 45	0.844	1.151	1.844	0.926
Average . . .	0.754	0.907	2.288	1.551

The first number in each case represents the unlimed plot.

Plots 8 to 15 inclusive received like treatment with reference to potash, and the average amount removed in the stalks from these plots, on the unlimed section (plot 11 A omitted from average), is 76.7 pounds per acre, the average amount removed in the stalks from plots 8 to 15 of the limed section is 72.6 pounds per acre. The average for all the plots in the unlimed section is 63.54 pounds per acre, and the average for all in the limed section 67.16 pounds per acre.

The stalks from plots 8 to 15 of the limed section yielded, with slight exception, somewat over 50 bushels of corn per acre. Thus it appears that the stalks from a 50 bushel crop of corn will remove about 75 to 100 pounds of potash. To this must be added about 12 pounds for the 50 bushels of grain. This brings the total amount well above the amount usually estimated for a 50 bushel crop of corn. The figures clearly indicate that in the case of some crops, or part of crops, it is useless to undertake to calculate the amount of potash removed by the crop unless the soil conditions and crop treatment are definitely stated.

POTASH IN OTHER CROPS.

Determinations of potash have been made in other crops or parts of crops, from certain of these plots. The samples on which determinations were made, were wheat straw, oat straw, oat grain, timothy hay and corn grain. The details of these analyses will not

be given here. It will suffice to state that the influence of the fertiliser and lime treatment is not as clearly and consistently reflected in the composition of the small grained plants as it is in the composition of the corn stalks. Nevertheless even here applications of potash salts increased, and applications of lime decreased, in most instances, the potash content of the crop.

SUMMARY.

Potash was determined in soils from a number of plots that had received definite fertiliser and lime treatment for a period of 15 years. It was also determined in several crops, or parts of crops, grown on the plots from which the soil samples were taken.

For the series of plots having parallel fertiliser treatment for the limed and unlimed sections, the percentage of potash in the soil was slightly lower, in nearly all cases, for the limed than for the unlimed section.

The fertiliser treatment does not appear to have had very much influence on the potash content of the soil. Such variations as are noted are to be attributed, in the main, to natural variations in the soil or to limitations in the methods of sampling.

There is a consistent variation in the percentage of potash in the corn stalks grown on the limed and unlimed sections and with the different fertiliser treatments.

The average percentage of potash in the stalks from 20 limed plots is, approximately, 0.4 per cent less than the average for the stalks from 20 limed plots.

The lowest percentage of potash found in the stalks was 0.426 per cent, and the highest 3.208 per cent.

It would appear that a 50 bushel crop of corn (maize), grain and stalks, will remove from the soil about 100 pounds of potash. It has been shown that the potash content of some crop, at least, is greatly influenced by heavy applications of potash salts and this emphazises the importance of carefully stating the conditions under which crops are grown when reporting percentages of plant food constituents in the crops.

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A. L. PRINCE.

ON THE PERMEABILITY OF CLAY SOILS.

I. — The formulation of the question and the methods of the investigation.

In my earlier investigations 1) I established the fact that the suspensions of the finest particles of soil produced from acid soils are much less sensitive to electrolytes than are the clay suspensions of neutral soils and soils containing $CaCO_3$. There is also the circumstance that the coagulation of the former clay suspensions is hindered much more powerfully by $NaHCO_3$, if this is in the solution together with calcium salts. As the permeability of the soil is connected with its degree of dispersiveness, it is conceivable that the low permeability of podsol soils, as regards water, is connected with the reaction, and consequently also with the formation process of these soils. The numerous data of analyses of podsol soils of various districts show that the development levels of different depths have also different mechanical and chemical composition. In this respect the podsol soils both of the Caucasus, which have developed at a yearly temperature of 12° C., and of the Italian Apennines, form no exception. The upper levels of the soil ($A_1 + A_2$) have not only lost their finest constituent parts, but also considerable quantities of Na and K, and even the coarser grains of the felspar and other minerals. The surface of the felspar of the upper level is always covered with a white or grey weathering skin. The Na_2O — and partly also K_2O — content of the skin is considerably reduced (1). The whole upper level ($A_1 + A_2$) has in some cases lost as much as 0.25 % K_2O and 0.5 % Na_2O, which, calculated on 1 hectare, means very large quantities of $NaHCO_3$ and $KHCO_3$. We now also find actually in the underground and surface waters very large Na_2O and K_2O contents, which have a detrimental effect on the physical qualities of the soil, and may reduce its permeability for water. The content of $NaHCO_3$ is especially high in the brown forest water, often exceeding 0.1-0.25 g. per litre, i. e., it reaches a concentration of about 0.0012-0.0030 n, which already has an injurious effect.

1) The work had to be abbreviated for editorial reasons; the literature cited by the author is appended at the close of the essay.

The object of the investigation was to find out the factors which reduce or increase the permeability of various kinds of podsol soils. The experiments were carried out with different levels of the podsol soil, especially with marl loams. The latter are often found in Latvia, and are to be regarded as mother-stone loamy podsol soils. All the experiments were carried out with pulverized air-dried soil, granulated through a 1 mm. sieve. Grains of 1-2 mm. diam. only were used in tests regarding the permanence of the structure of the soils, the finer constituent parts being sieved off in this case.

After numerous preliminary tests, I found the following apparatus the most suitable (Illustration 84). The apparatus consists of a bottle or Erlenmeyer flask, a little tube with perforated end (the perforation is very simple to carry out on a spirit lamp with a blowpipe) and a round flask containing 100-400 ccm. Instead of the latter, a bottle with a perforated stopper can be used. A glass tube 6-8 cm. long by 0.8-1.0 cm. diam. comes into the stopper. I used 10 g. of soil for the tests. The soil came into the tube, the perforated end of which was covered with a little wadding. It is an advantage also to draw the wadding into the hole with the aid of a small wire. The tubes were the usual 16 cm. long and 1.6 cm. diameter. These glasses are also advantageous because their diameter is $2cm^2$, which facilitates the calculation of the filtrate corresponding to the depth of the water layer, as the deposits are designated: 2 ccm. of the filtrate corresponding to 10 mm. of the deposit. 10 g. of soil occupy about 4.5-5.5 cm. of the length of the tube, according to the density of the soil. In filling the soil into the tube I mixed it up again by turning the tube round. After filling, the little tubes were furnished with a rubber ring, a piece cut off a rubber pipe, with an edge which was not smooth, so that the air should not be cut off. The rubber ring does not allow the little tube to sink into

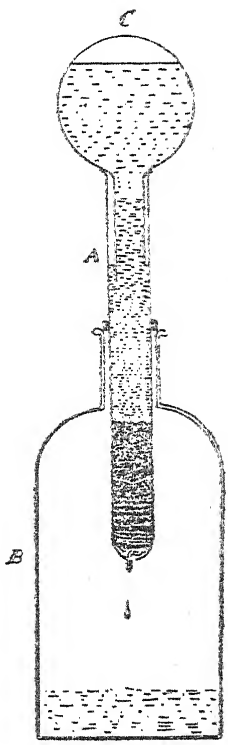

FIG. 84. — Apparatus for investigation of permeability.

the bottle or Erlenmeyer flask. Then the tube is filled with water over the soil, up to 12 cm. from the lower end of the tube. The third part of the apparatus is a round flask, which holds water to a certain height. The little flask is filled with water or with the salt solution to be examined, and stuck into the tube neck downwards. If the water in the tube sinks so far that air comes between the tube and the neck of the flask, then the air will immediately penetrate into the flask, and a sufficient quantity of water will flow out into the little tube to again shut off the neck of the flask from the air. The principle of the apparatus can also be adapted to sand and other materials easily permeable by water; in this case a larger bottle must be used, into which the little tube goes, and a larger round flask for holding the water or salt. In this case the round flask must be fixed to a support, as the little tube may break in pieces if the flask contains more than 400 ccm. of liquid. In order that the water can easily flow out of the flask into the tube, the neck of the flask must have a diameter of about 0.8-1.0 cm., and be cut off obliquely at the end.

After a few preliminary experiments I have found the best amount to be 10 g. of soil in conjunction with a depth of filtering material of about 5 cm. If the filtering layer is deeper, then relatively small quantities of filtrate are obtained ; if the latter is smaller, however, then the finest constituent parts of the soil are many times vigorously washed, and those salt solutions which increase the degree of dispersiveness filter even more quickly than distilled water. This circumstance is of especial significance in the experiments with « Gley » soils : thus, for example, the filtration through a layer of « Gley » soil 5 cm. deep was distinctly retarded by a 0.0001 n $NaHCO_3$ solution, but the filtration through a layer 2 cm. deep of the same soil was furthered because in the first case the pores were stopped up by the finest constituent parts of the soil, whereas in the second case these finest constituent parts were washed out, and filtration consequently increased. The quantities of water filtered through the soil were measured, the measurement being for the most part carried out once a day. In the tests extending over several months, even two years, the measurements were carried out more seldom, every two days, and in some cases every twenty days.

With good mixing of the soil, and good filling, the parallel measurements give mostly correspondingly good results, especially good with marl loams and neutral soils. With very acid soils, the deviations fo the parallel determinations are greater, especially with the examina-

tion of such solutions as increase the degree of dispersiveness of the finest constituent parts of the soil. The differences in the quantities of filtrate are in this case particularly great for a single day, whereas the total quantity of filtrate for a longer period shows small differences in the parallel determinations. The alterations in permeability apparently are here very erratic, being suddenly reduced or increased. That is quite comprehensible; if the finest particles are taken out of the soil with the filtrate, then stopping up or freeing of the pores occurs, which requires no special explanation. The methods described for investigating permeability cannot give results which are equal in accuracy to those obtained by the methods of analytical chemistry. Still, even with these methods, very many complicated questions can be answered. This method withal is very simple, requires no expensive apparatus, no great space, and is suitable for carrying out very numerous parallel examinations of long duration. In the simply equipped laboratory I have carried out up to now about 300 such examinations, lasting at least a month each, which have already led to many important conclusions, and these I will consider briefly in the present work.

With such an apparatus, the influence of the water pressure on filtration, and the stopping up of the pores, can be demonstrated in lectures, by the use of quartz sand (grains about 0.15 mm.) as a filtering layer and diluted clay suspensions for filtration. To obtain greater water pressure, instead of the little tube a longer piece of corresponding glass tube can be used.

II. — Experiments with marl loams.

Three different kinds of marl loam have been examined. I. Band clay of about 3 m. deep, with a $CaCO_3$ content of 28.37 %. The sample of soil originates in the district of Tuckum, in the neighbourhood of Renge. II. Band clay from the neighbourhood of Kauzmünde, of a depth of 50-60 cm., $CaCO_3$ content 4.02 %. On the band clay was a little changed neutral soil similar toRendzine soil. The $CaCO_3$ content of the deeper layers of band clay rises to 20 % ; therefore the upper layers of the band clay must be considered as pretty strongly washed out, having lost up to 16 % of their original $CaCO_3$ contents. III. Unstratified marl loam of a depth of 60-70 cm., from the neighbourhood of Kursichi, district of Goldingen. Typical podsol soils have already formed on the marl loam.

All three marl loams mentioned are very rich in the finest constituent parts of soil, clay particles which do not deposit in the course of 24 hours from a suspension 10 cm. deep ; this is particularly so with the last two samples of soil. This is seen from the following data :

TABLE I. — *Mechanical composition of the marl loam.*

Size of grain *) in mm.	Time of deposit	I	II	III
		%	%	%
1 — 0.05 mm.	1 minute	6.47	7.24	48.57
0.05 — 0.01 mm.	10 »	16.48	19.0	14.03
0.01 — 0.005 mm.	6 hours	41.91	—	17.11
0.005 — 0.001 mm.	24 »	11.70	73.76	5.76
under — 0.001 mm.	—	23.44	—	14.63

The size of grain is designated after Prof. W. R. WILLIAMS, *Nachrichten der Akademie Petroffskaja* 1889. The microscopic check has shewn that the size of grain is somewhat different, thus for example, particles whose diameter is rather smaller, about 0.003 mm, are deposited in 6 hours. The samples of soil were in this case prepared for mechanical analysis by heating slowly with a few drops of NH_3. The $CaCO_3$ was not separated. All further mechanical analyses carried out in this treatise are obtained with ammonia without heating. The samples of soil were however prepared by treatment with NaCl normal solution after Prof. K. GEDROIZ.

The two first marl loams contained no constituent parts which were larger than 1 mm., the last sample contained 17.2 % of such ; these particles were, however, granulated, and for the tests only soil was used which had been put through a 1 mm. sieve.

Although the loams contain fairly large quantities of constituent parts which were not deposited in the course of 24 hours, yet the ultra-mechanical constituent which is not deposited within three weeks could not be obtained by treating the soil several times with normal NaCl solution in accordance with the methods of GEDROIZ (2). After the washing out of the NaCl, fairly large quantities of Ca ions passed over into the solution, by which the finest constituent parts were pretty quickly coagulated. The explanation of this fact must indeed be sought in the influence of the NaCl on the $CaCO_3$; this raises the hydrolytic decomposition of the $CaCO_3$. My last investigations show that with $NaHCO_3$ and NH_3 better results can be obtained, because the $NaHCO_3$ and NH_3 reduce the hydrolysis of $CaCO_3$.

(a) *Experiments with band clay of the deeper layers of soil from Renge.* — The results are to be seen from the curve of Illustration 85, in which the quantities of filtrate which passed through the soil in the first 21 days are set out graphically. The quantities of filtrate are shewn on the ordinate axis, the days on the abscissa axis. The experiments were carried out with : I. distilled water, II. saturated Ca $(HCO_3)_2$ solution of about 0.02 normality ; the solution also contained free CO_2, III. CaSO4 solution of 0.012 normality ,IV. with water saturated with CO_2 (about 1 g. CO_2 to the litre).

The permeability was lowest for distilled water, but also very constant at about 3 ccm. per day ; only in the last weeks of the experiment did the permeability rise to 4 ccm. per day.

The permeability for $Ca(HCO_3)_2$ solution was also low; it was

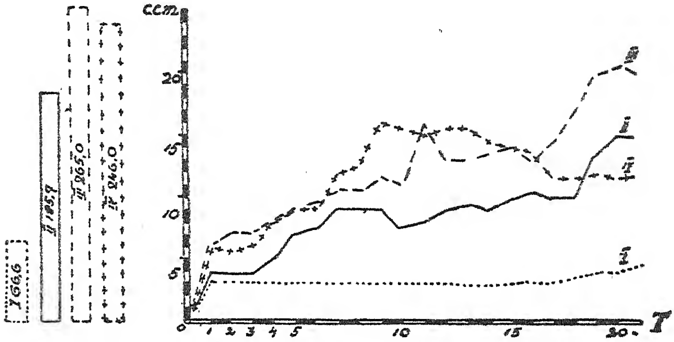

FIG. 85. — Experiments with band clay from Renge.

I. .... Distilled water.
II. ————— 0.02 n Ca $(HCO_3)_2$ solution.
III. -------------- 0.012 n $CaSO_4$ solution.
IV. ++++++ CO_2 = solution about 0.5 = 1 g. CO_2 per litre.
Left = Total quantity of filtrate in 21 days.

only at the end of the experiment that a quick rise of permeability was noticeable.

The greatest quantities of filtrate were obtained with $CaSO_4$ solution ; in this case also a quick rise in the permeability is observable at the end of the experiment.

With water saturated with CO_2 a quick increase in permeability was produced in the first nine days of the experiment ; afterwards the permeability became gradually lower.

(b) *Experiments with band clay from Kauzmünde.* (*CaCO3* = 4.02 %. — The results of the experiments are graphically represented

in Illustration 86. These come very near to those of the first band clay, especially with distilled water. The influence of the electrolytes $CaSO_4$ and $Ca(HCO_3)_2$ was in this case greater from the very be-

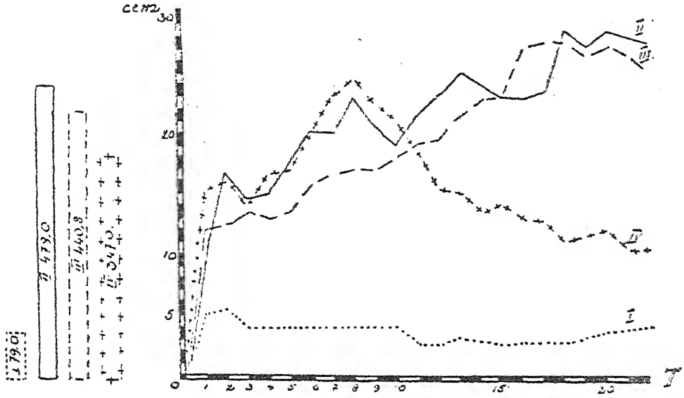

FIG. 86. — Experiments with marl loam from Kauzmünde.

I. .... Distilled water.
II. ————— 0.02 n $Ca(HCO_3)_2$ solution.
III. -------------- 0.012 n $CaSO_4$ solution.
IV. +++++ CO_2 solution about 0.5 = 1 g. per litre.
Left = Total quantity of filtrate in 22 days.

ginning. With water saturated with CO_2 a strong rise in permeability was here produced at the beginning followed by a correspondingly rapid fall from the 8th day.

(c) *Experiments with rubble marl loam, on which podsol soil is formed.* — The results are graphically represented in Illustration 87. The permeability of the rubble loam was on the whole higher than that of the first two band clays. There was a particularly steep rise of permeability at the beginning, under the influence of gypsum, and on the 5th day it reached the extent of 75 cm. per day. It is characteristic that in this experiment the permeability was not increased at all under the influence of the $Ca(HCO_3)_2$ solution. The experiment with $Ca(HCO_3)_2$ solution lasted 30 days, the others several months (The curve only shows the data for the first 60 days). After 36 days the soil in the little tube was stirred by a wire, which however had no special influence on the permeability, in fact pronounced reduction of permeability took place in the experiment with distilled water. From the 40th day onwards the $CaSO_4$ solution and distilled water still remaining in the little tube was replaced by a 0.01 n solution of

$Ca(OH)_2$. The permeability for $Ca(OH)_2$ solution after gypsum mounted very steeply and afterwards for four months, to the end of the experiment, kept constant at 55-50 cm. per day.

No influence of the Ca $(OH)_2$ solution, after distilled water, was observable in the course of 8 months. Not until then did the permeability rise somewhat, up to 6 ccm. per day, and not until after 16 months did it reach the height of 7 ccm. per day. At first the Ca $(OH)_2$

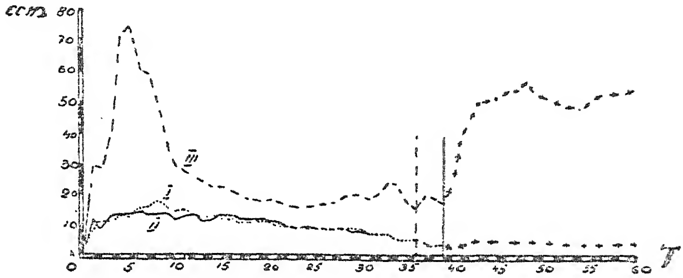

FIG. 87. — Experiments with rubble marl loam from Kursischi.

I. .... Distilled water.
II. ————— 0.01 n $Ca(HCO_3)_2$ solution, interrupted after 31 days
III. --------------- 0.012 n $CaSO_4$ solution.
++++++ Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution. The soil was stirred after 36 days.

was greatly absorbed by the marl loam, and the filtrate was not coloured with phenolphtalein until after 1 ½ months, when more than 200 ccm. $Ca(OH)_2$ solution had already passed through the layer of soil. Even after the $Ca(OH)_2$ had appeared in the filtrate, no alterations in permeability were observable, with the exception of the increase of the quantity of filtrate by 0.2 ccm. per day. Several special investigations were carried out regarding the influence of Ca $(HCO_3)_2$ on the rubble loam, from which it can be established that the permeability for these electrolytes is very small. Closer examination of the filtrates showed that they contain $NaHCO_3$, and in pretty high concentrations, at the beginning as much as 0.0035 n, after a month about 0.0015 n, and even 8 months still 0.0004 n. Experiments with other levels of the podsol soils gave much lower $NaHCO_3$ content in the filtrate. It may be assumed that the $NaHCO_3$ content also has an effect on the alterations of the $Ca(HCO_3)_2$ concentrations: in the filtrate through marl loam the latter, after 8 months, was only of 0.0018 normality, whereas the filtrates through other levels of Podsol soils showed concentrations of $Ca(HCO_3)_2$ of 0.0028-

0.0040 normality. As $NaHCO_3$ has the same anion as $Ca(HCO_3)_2$, it favoured the separation of $CaCO_3$. In the filtrates through the upper levels of the podsol soils the $NaHCO_3$ content was at the beginning only of 0.001 normality; after 8 months, however, in the filtrate through level A = 0.0003 N., through level B = 0.00004 N.

The filtration of 1 litre of $Ca(HCO_3)_2$ solution through a layer of marl loam 1 cm. deep produced the following quantities of K_2O and Na_2O per 100 g. soil:

	K_2O	Na_2O
	g.	g.
Band Clay from Renge	0.0096	0.0057
Stony marl loam from Kursischi	0.0038	0.0085

These data show that the rubble marl loam really contains greater quantities of Na_2O than the band clay from Renge, which, in the experiment conducted, may have had an effect on the permeability for the $Ca(HCO_3)_2$ solution. The influence of the gypsum solution on permeability must have been more favourable, because in this case no $NaHCO_3$ can have arisen as a product of chemical change, only Na_2SO_4.

Illustration 88 gives a graphic representation of the effect of the 0.01 n $Ca(OH)_2$ solution on the permeability of the rubble loam (Line C); although the experiment was continued for longer than 6 months, the permeability never rose particularly steep and high, and the greatest quantity of filtrate was only 15 ccm. per day. In the course of the experiment reduction and increase of permeability was observable several times. It is characteristic that the permeability was smallest at the beginning of the experiment, between the second and sixth days. The data obtained shows *that the permeability of the marl loams for distilled water, and also for the electrolytes examined, even in experiments of very long duration, does not increase, although great fluctuations are observable in the permeability. In all cases the permeability was raised by gypsum solutions, also the permeability for $Ca(OH_2)$ solution was much greater* (10 *times*) *after gypsum than after distilled water.* It must be pointed out that in all the experiments with marl loam the filtrates were perfectly clear, without any cloudiness. I tried to filter clay suspensions of the finest constituent parts of soil of acid podsol soils through marl loam, but in these cases also

the suspensions were already coagulated on the surface of the filtering bed, and did not even penetrate into the loam if the depth of the filtering bed was reduced to 2 cm.; the suspensions filter almost as quickly as distilled water. As permeability was favourably influenced

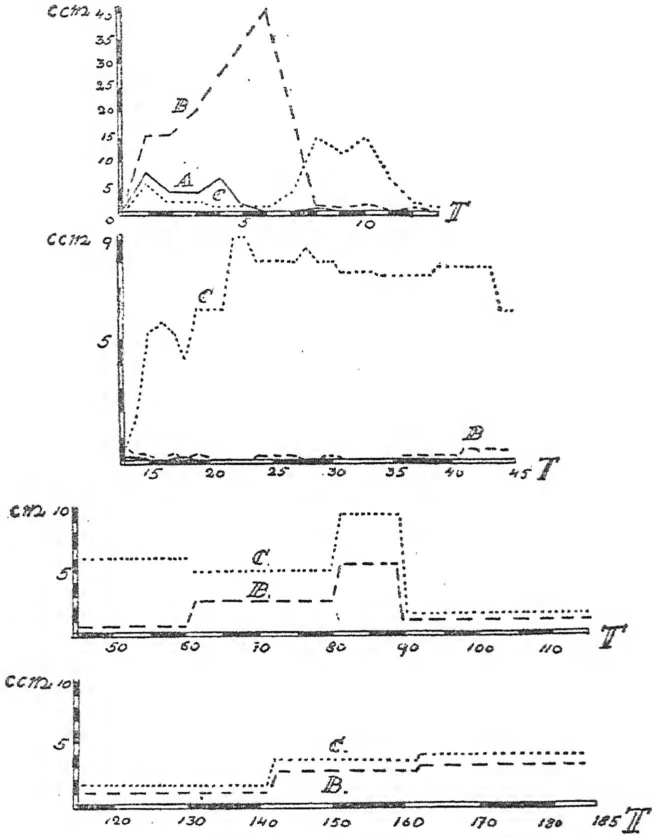

FIG. 88. — Permeability of the 3 levels of Podsol soil for 0.01 n $Ca(OH)_2$ solution in 185 days.

———— Level A: After 6 days the permeability is already almost completely interrupted, after 30 days completely interrupted, and does not rise again.

-------- Level B: The permeability is interrupted after 31 days, but afterwards rises again.

.... Level C: The permeability is not interrupted.

by gypsum solution, I made thorough investigations with gypsum and band clay from Renge. The following concentrations of gypsum were

examined: 0.012 n, 0.006 n, 0.003 n, 0.0015 n, 0.0007 n, and distilled water was used as control. At the beginning the permeability was much increased by the first four concentrations of gypsum, by the highest concentration up to as much as 30 cm. per day, but afterwards the permeability fell gradually and the differences were equalized. The permeability for distilled water after 40 days was 3 ccm. per day, for gypsum solutions, even the weakest, 6-10 cm. per day. After 40 days the gypsum solutions were replaced by 0.01 n, solutions of $Ca(OH)_2$ and the experiments continued for another 3 months. The permeability for Ca $(OH)_2$ was considerably increased in those samples through which Gypsum solutions of 0.0015-0.012 n were previously filter ed. The quantity of filtrate with $Ca(OH)_2$ in the sample after the weakest concentration of gypsum, 0.0007 n, was even smaller, although in the filtrate from this sample also traces of $Ca(OH)_2$ were noticeable after a month. Before the appearance of Ca $(OH)_2$ in the filtrate, great fluctuations of permeability were observed, from 1-6 ccm., per day and on 3 days the permeability was even completely interrupted, which points to the stopping up of the pores of the soil, and afterwards unstopping. At the close of the experiment the permeability for $Ca(OH)_2$, after the four stronger concentrations of gypsum, reached 14-27 cm. per day, after the lowest concentration 5 ccm., after distilled water 7 ccm. per day.

With band clays I and II (from Renge and Kauzmünde) I made tests, after the gypsum and $(Ca(HCO_3)_2$ solutions, with distilled water. The tests lasted only 10 days, the permeability was considerably reduced.

Finally, tests were again made with the rubble loam with different concentrations of $NaHCO_3$. The results of these tests are not graphically represented, but they speak for themselves.

$NaHCO_3$ in the concentration of 0,05 n greatly reduced the permeability. The experiments with 0.001 n $NaHCO_3$ solution and distilled water were carried out twice with good corresponding results. All other concentrations of $NaHCO_3$ which were examined reduced the permeability, with the exception of the concentration of 0.00003 n, with which the permeability was almost equal to that for distilled water. It is hardly probable that such weak $NaHCO_3$ solutions as 0.0000001 n could so strongly influence the permeability; it may be that in this case other factors, remaining unknown, were decisive. The filtrates in all these experiments were also perfectly clear, with the exception of the concentrations of $NaHCO_3$ of 0.001 normality;

TABLE II. *Experiments with rubble loam with different concentrations of $NaHCO_3$.*

	Concentrations of $NaHCO_3$ in terms of N/1	Quantites of the filtrate in 20 days in ccm.
1	0.05	26
2	0.001	178
3	0.001	163
4	0.0003	171
5	0.0001	187
6	0.00003	246
7	0.00001	188
8	0.000003	160
9	0.000001	142
10	0.0000003	143
11	0.0000001	175
12	Distilled water	262
13	» »	280

in this experiment a very weak opalescence, and in time a very slight deposit were noticeable. This was the only case in the experiments with marl loams.

In my earlier treatise on the coagulation of clay suspensions I have already given expression to the assumption that marl loam, under the influence of $Ca(HCO_3)_2$ solutions, develops $NaHCO_3$. In the investigation submitted I have not indeed been able to establish the pronounced retarding influence on coagulation of the marl loam, still it may be assumed that in the filtration experiments the $NaHCO_3$ raises the degree of dispersiveness and hinders filtration. This may be concluded also from the high $NaHCO_3$ contents of the filtrates on filtration of the $Ca(HCO_3)$ solution.

I have already established that the permeability of marl loams is raised more strongly by gypsum solutions than by $Ca(HCO_3)_2$ solutions, especially those marl loams on which Podsol soil has already developed, and consequently larger $Na^{\cdot}$ and $K^{\cdot}$ ions from the transformed upper level have trickled through the soil. With the absorbed $Na^{\cdot}$ and $K^{\cdot}$ ions gypsum gives no carbonic acid but sulphates, whose influence is different. In time, however, the permeability of the gypsum solutions is also reduced; it is conceivable that in this case those $Na^{\cdot}$ and $K^{\cdot}$ ions operate which arise on the hydrolysis of the silicate. That this hydrolysis takes place in experiments extending over several weeks can be seen from the fact that hydrocarbonates can be found in this case in the gypsum solution which filters off, even if the filtering soils contain no $CaCO_3$.

Experiments with loams free from $CaCO_3$.

For the experiment level B of the podsol soil was used, the same from which the clay suspensions were obtained with which the experiments regarding coagulation were carried out. The sample of soil was taken from the same place in the neighbourhood of Kursischi, from which also the rubble loam was taken, and was found directly over the latter. The content of CaO soluble in hot hydrochloric acid is pretty high, namely, 0.93 %, though this loam after a few hours shows acid reaction on litmus paper. The explanation is to be sought in the very fine grained mechanical composition. The mechanical analysis was carried out by the method of Prof. GEDROIZ, in pursuance of which the the loam was first treated 15 times with normal NaCl solution. The mechanical composition was as follows:

TABLE III. — *Mechanical composition of the sample of soil.*

Size of grain in mm.	Time of depositing from water 10 cm. deep.	Contents of little grains in %
1 — 0.05	1 minute	35.64
0.05 — 0.01	10 minutes	7.56
0.01 — 0.005	6 hours	12.12
0.005 — 0.001	24 »	6.05
0.001 — 0.00022	3 weeks	11.78
below — 0.00022	—	23.63

In this case the sample of soil was not heated. In the analyses with which samples of soil of the same loam were previously prepared by heating with NH_3, I only obtained 24.36 % of grains which were not deposited in 24 hours; with the kind of preparation now used this amount is raised to 35.41 %.

It must be mentioned as a characteristic of the loam that it is fairly rich in K_2O and Na_2O, as is shown by the following data:

	K_2O	Na_2O
I Dissolves in hot 10 % HCl	0.555 %	0.05 %
II » in cold 0.015 n. HCl	0.015 %	0.019 %
III » out of 100 g. soil in 1 litre 0.02 n Ca $(HCO_3)_2$!	0.0042 g.	0.0043 g.

This loam proved particularly sensitive in the experiments for permeability. The results of the examinations are shown graphically in Illustration 89.

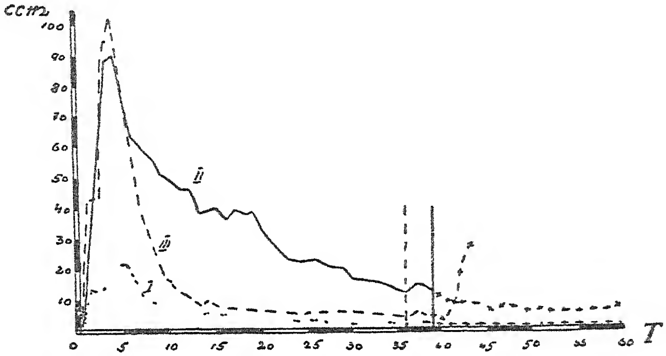

FIG 89 — Experiments with level B of the Podsol soil from Kursischi.

I	.	Distilled water
II	————	0 01 n $Ca(HCO_3)_2$ solution
III	- - ------ --	0 012 n $CaSO_4$ solution
	+ + + + +	Continuation of the experiment with 0 01 n $Ca(OH)_2$ solution Stirring up of the sample of soil on the 36th day

Distilled water filters pretty well at first, but the quantity of filtrate already reaches its maximum (22 cm. per day) on the 5th day, and afterwards falls fairly fast after 30 days almost reaching 0. The breaking up of the sample of soil, which was done between the 36th and 39th days, also had no effect. After 40 days the experiment was interrupted, and instead of distilled water 0.01 n $Ca(OH)_2$ solution was used. This solution also had no influence, the permeability was not raised. This loam proved much more sensitive to $Ca(HCO_3)_2$ and $CaSO_4$ solutions. The permeability was greatest for gypsum solutions and on the 4th day reached the quantity of 102 ccm per day, which must be described as a very great amount. The permeabilbility fell very fast in the following days, however, and the breaking up of the soil then carried out had no effect. After replacing the Gypsum solution with $Ca(OH)_2$ the permeability again rose rapidly. The permeability of the loam was also much increased by $Ca(HCO_3)_2$ solution, and with this did not become less so quickly as in the experiments with gypsum solution.

The influence of various stronger concentrations of $Ca(HCO_3)_2$ solution on the permeability of the loam were also investigated. Illustration 90 shows the total quantity of filtrate in 21 days. Each concentration was examined in two parallel tests, and results were obtained which corresponded pretty well with each other. After 21 days, instead of $Ca(HCO_3)_2$ solution, a 0.01 n solution of $Ca(OH)_2$ was used. With this the permeability in all samples was very much

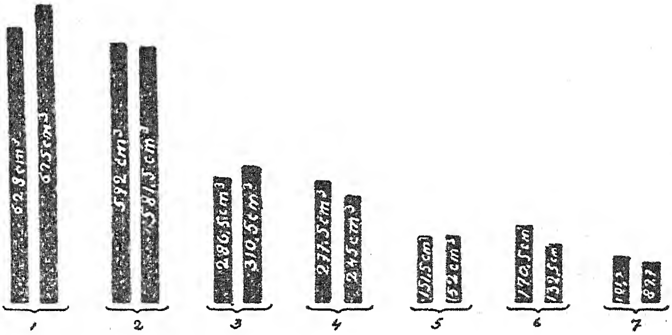

FIG. 90. — Level B of the Podsol soil. Quantities of filtrate in 21 days with distilled water and different concentrations of the $Ca(HCO_3)_2$ solution.

No. 1 = 0.02 n, No. 2 = 0.01 n, No. 3 = 0.005 n No. 4 = 0.0025 n, No. 5 = 0.0012 n, No. 6 = 0.0006 n, No. 7 = distilled water.

reduced, and only after several months did it rise again in the first four tubes to 10-20 ccm. per day. The experiments were continued for 15 months. The general impression at the conclusion of the experiment was as follows: The permeability of the samples of soil, after previous filtration of $Ca(HCO_3)_2$ solutions of 0.02 n, 0.01 n and 0.0025 n, amounted to 7 - 15 ccm. per day, with which similar variations were also observable in parallel examinations. The permeability for $Ca(OH)_2$ of the remaining samples of soil, after previous filtration of the remaining $Ca(HCO_3)_2$ solutions of 0.003, 0.0012 and 0.0006 normal and also of the distilled water, was almost completely eliminated becoming not greater than 0.5 ccm. per day.

Direct examination of the 0.01 n $Ca(OH)_2$ solution (illustration 88) showed that the permeability rose pretty quickly, on the 4th day attained 41 ccm. per day, but already on the 8th. day stopped almost completely, not to rise again until after 40 days. At the conclusion of the experiment the quantity of filtrate amounted to 3 ccm.per day.

A 0.05 n and 0.001 n solution of $NaHCO_3$ were also examined. In 20 days the total quantity of filtrate amounted to:

0.05 n $NaHCO_3$	42 ccm.
0.001 n »	123 ccm.
Distilled water	117 ccm.

The filtrates after distilled water and 0.001 n $NaHCO_3$ were not quite clear, but opalescent, but with the 0.05 n $NaHCO_3$ solution no solid constituent parts were washed out of the soil. It is interesting to note that the weaker concentrations of $NaHCO_3$ exerted no retarding effect on the filtration.

The qualities of the loam examined are very bad in nature, it is therefore described as "sticky" and "builder's" loam. Through the level of the loam mentioned, on the development of podsol soil, the washed out levels ($A_1 + A_2$) of the rubble loam are eliminated. The permeability of this loam is very greatly influenced by drying, as also by deeply penetrating freezing of the damp soil; if, however, the soil has been very damp for a long time, the permeability will be greatly reduced. The experiment carried out, which shows the increase of permeability with the $Ca(OH)_2$ solution after gypsum, leads to the assumption that the qualities of the loam mentioned can be improved by gypsum solutions. It is possible that the contents of absorbed $K^{\cdot}$ and $Na^{\cdot}$ ions in the loam are reduced by gypsum solutions.

Experiments with humus levels.

In these experiments great variety could always be observed after the reaction of the humus levels. The permeability of neutral samples of soil differs greatly from that of acid samples.

For the first experiment a neutral soil from the neighbourhood of Sigulda was used. This soil contained 12.2 % of particles finer than 0.01 mm., 3.2 % humus, and 0.86 % $CaCO_3$. The results of the experiments are represented in Illustration 91. On the first day of the experiment the permeability for distilled water reached 91 ccm. per day, but then became fairly quickly and considerably reduced, and amounted to only 9 ccm. per day on the 18th day. From the 18th to the 25th day 0.12 n gypsum solution was used instead of

distilled water, but this did not exert any special influence; later, however, a 0.01 n $Ca(OH)_2$ solution was used, by which the permeability was increased in the next 7 days to 80 ccm. per day. From the 32nd. day onwards distilled water was again used, and consequently the permeability was again quickly reduced.

More thorough investigations were made with two other samples of soil; the 1st similar to the Rendzine soil is neutral, from the neighbourhood of Kauzmünde, containing 4.34 % humus and 0.43 % $CaCO_3$; the 2nd soil is typical Podsol soil, of a similar kind to that whose clay suspensions were investigated in an earlier work. It contains 2.52 % of organic matter, which, however, is but slightly decomposed and cannot really be designated as humus. Lime-marl, reckoned as $CaCO_3$, amounts to 0.25 %. The soil of course contains no $CaCO_3$. The quantity of CaO soluble in hot HCl amounts to 0.089 %. The mechanical composition of the soil can be seen from the following data (see Table IV page 571.

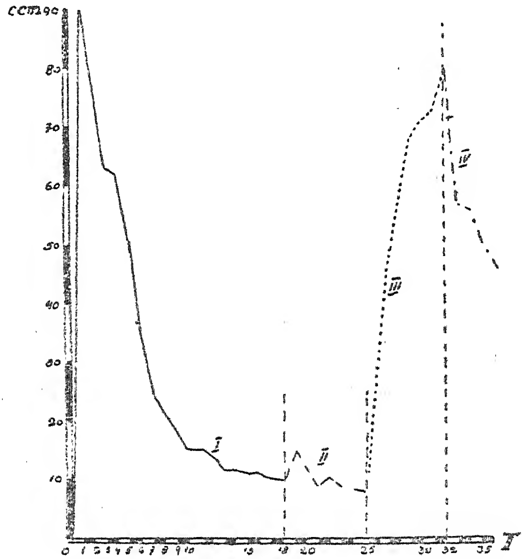

FIG. 91. — Permeability of level A of the neutral arable soil from Sigulda.

I. ———— Distilled water.
II. -------------- Continuation of the experiment 0.012 n $CaSO_4$ solution.
III. .... Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution.
IV. —.—.—.—. Continuation of the experiment with distilled water.

In comparison with the above mentioned marl loam, both the soils mentioned have much coarser composition. Both soils were prepared for the mechanical analysis by treating the sample of soil 15 times with NaCl n solution. This treatment was quite sufficient for the acid soil, but in the neutral soil the constituent parts which

TABLE IV. — *Mechanical composition of both samples of soil.*

Size of grain in mm.	Time of depositing	Contents in %	
		Neutral soil	Acid soil
1 — 0.05	1 minute	36.8	41.38
0.05 — 0.01	10 minutes	33.30	18.18
0.01 — 0.005	6 hours	18.88	23.76
0.005 — 0.001	24 »	3.38	6.26
0.001 — 0.00022	3 weeks	2.54	6.35
below 0.00022	—	2.31	3.30

were not deposited in 6 hours still contained fairly large quantities of coagulated particles and organic matter; the mechanical composition of this soil must therefore be fine grained. It is also characteristic that on washing out with salt solution, great quantities of organic matter from the neutral soil went into solution, but very little from the acid soil. The colour of the soils was also dissimilar: that of the neutral soil almost black, of the acid bright grey. Also the contents of Na_2O and K_2O in the podsol soil were fixed:

	K_2O	Na_2O
Dissolves in hot HCl	0.165 %	0.021 %
» in cold 0.05 n HCl	0.010 %	0.013 %
» out of 100 g soil per litre Ca $(HCO_3)_2$. . .	0.0026 g!	0.0042 g.

The results of the examination of the neutral soil with distilled water are represented in Illustration 92.

The permeability at the beginning increased quickly, on the 4th day it already reached almost 200 ccm. per day, which can be described as the maximum permeability for water in my experiments with loamy soil. Afterwards the permeability fell quickly and by great bounds, and after 183 days it amounted to only about 0.2 ccm. per day; after another month no more filtration took place; after 3 months however, therefore 10 months from the commencement of the experiment, the lower part of the soil in the test tube began to dry up, although water was present for the whole time in the tube and also in the round flask.

The results of the examination of the neutral soil with 0.01 n $Ca(OH)_2$ solution are represented in Illustration 93. The permeability for this solution was at the beginning even greater than 200 ccm. per day; afterwards it was indeed reduced, but never fell below 15 ccm.

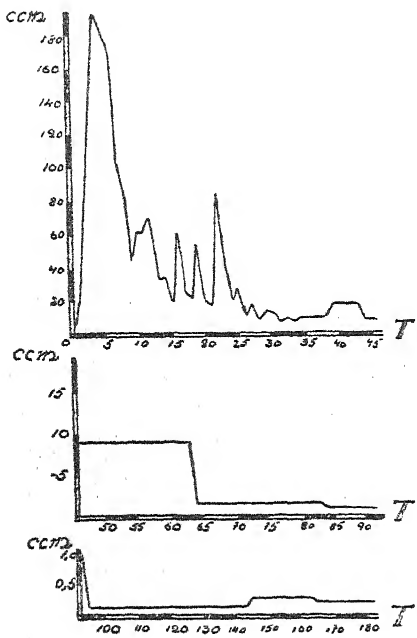

FIG. 92. — Permeability of the upper level of neutral arable soil from Kauzmünde in 183 days. On the continuation of the experiment the permeability was completely interrupted.

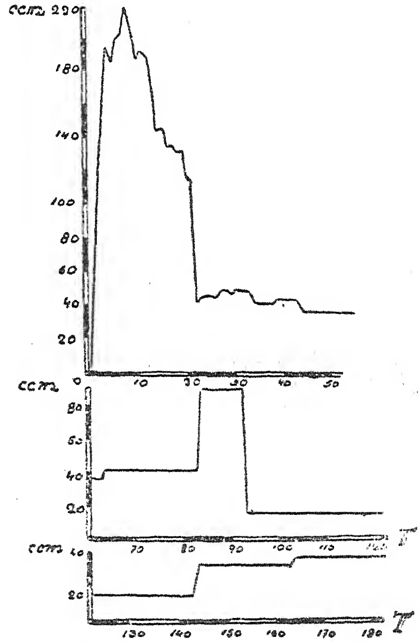

FIG. 93. — Permeability of the upper leve l of the neutral arable soil from Kauzmünde for $Ca(OH)_2$ solution.

per day. After 6 months, at the conclusion of the experiment, it amounted to almost 40 ccm. per day.

We see quite another picture on the examination of the acid Podsol soil. The results of these examinations are represented in Illustration 94.

Although the soil has no great quantities of the finest constituent parts, the permeability for distilled water is very low. The permeability was raised by $Ca(HCO_3)_2$ and $CaSO_4$ solutions, although relatively little, the effect of the $Ca(HCO_3)_2$ solution being the greater. Here also the breaking up of the soil did not help. From the 39th day onwards 0.01 n $Ca(OH)_2$ solution was filtered through all the test

tubes. The permeability for this salt also was very slight. The filtration of the $Ca(OH)_2$ solution was still continued for 4 months, with which at the close of the experiment the permeability in all the tubes was almost alike, about 1 ccm. per day. During the whole period of the experiment the filtrate gave no colouring with phenolphtalein, the $Ca(OH)_2$ was therefore absorbed the whole time from the soil through which the solution trickled. The absorption must

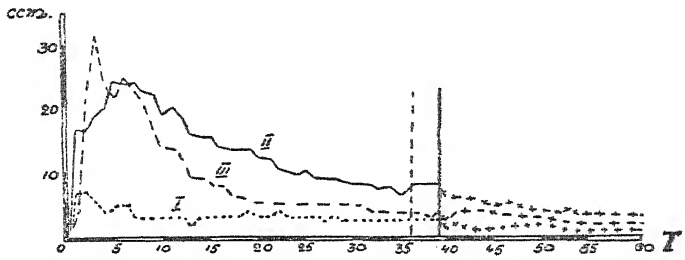

FIG. 94. — Experiments with level A of the podsol soil.

I. .... Distilled water.
II. ———————— 0.02 n $Ca(HCO_3)_2$ solution.
III. ---------------- 0.01 n $CaSO_4$ solution.
++++++ Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution.

probably in this case also be considered as the main reason why the permeability for $Ca(OH)_2$ was not greater under the conditions of the test.

Illustration 88 shows us the results of the comparison when from the beginning onwards $Ca(OH)_2$ solution is filtered through acid soil. The permeability indeed is increased at the beginning, but does not exceed 7 ccm. per day; after 6 days, however, scarcely any filtration takes place.

Only 2 concentrations of $NaHCO_3$ — 0.05 n and 0.001 n — were examined. The permeability for these solutions, in comparison with distilled water, showed no great difference; in 20 days the following quantities of the solution passed through:

0.05 n $NaHCO_3$	= 81 ccm.
0.001 n $NaHCO_3$	= 76 ccm.
distilled water	= 95 ccm.

In all experiments with distilled water, $NaHCO_3$, Ca $(OH)_2$ (the latter was completely absorbed by the soil) considerable washing out of the finest constituent parts of the soil was observable. The filtrate

was cloudy, and a portion of the cloudiness deposited itself in the flask as fine sand. With this a characteristic layer developed in the test tube which was very easily seen. Such layers occur also in the loam (level B) in the experiments with distilled water, and in the clay soil, but never in the marl loams. Regarding the dried experimental soil which exhibited layers, I was not successful in dividing this into individual layers, as I had been with the band clays. Such stratification can also be observed in the upper levels of the Podsol soils, which are much washed. The formation of the layer is regarded by Prof. K. GLINKA (3) as the result of a high degree of dispersiveness of the soil. The commencement of the formation of the layers can already be seen after a few days in the experiments with distilled water, after a few weeks, however, the layers are already very well formed, the layers at the lower end of the tube being formed the best, but in the experiments with $NaHCO_3$ also in the upper part. In all experiments with acid soils, especially with levels A_1 and A_2 of the podsol and clay soils, strong washing out of the $Fe(OH)_3$ could be observed, whereas in the experiments with neutral soils and soils containing $CaCO_3$ no notable washing out of $Fe(OH)_3$ could be observed.

Experiments with gley loams.

As "gley" loams are described the upper levels of such more or less loamy soils as are greatly transformed under the influence of excessive moisture and organic matter. The loam acquires a blue grey colour, is very sticky when in a damp condition, and very hard in a dry condition. Pits dug in gley loam, and open ditches, soon fill up, because the sides soon fall in. The content of clay particles in the gley loam is very varied, from 10-70 % and more. The permeability for water is very small, often even drains act badly in gley loam, for the water forces its way to them with difficulty. The upper levels of the gley loam contain no $CaCO_3$, they have even a strongly acid reaction; at a relatively small depth, however, we find marl loam but it has very bad physical qualities. The gley loams contain small quantities of organic matters, the upper level, however, contains large quantities of the same, which are acid.

We find typically formed gley loam on making a vertical cutting of the earth where the subsoil is loamy; the width of the gley loam seldom exceeds 20-50 cm.

The experiments were carried out with 2 gley loams, the first

from the neighbourhood of Kasdanga, the second from Sigulda. The mechanical composition of these gley loams is as follows :

TABLE V. — *Mechanical composition of the two samples of gley loam.*

Size of grain in mm.	Time of depositing	Contents in %	
		I. Kasdanga	II. Sigulda
1 — 0.05	1 minute	4.14	24.70
0.05 — 0.01	10 minutes	14.34	30.60
0.01 — 0.005	6 hours	28.60	22.50
0.005 — 0.001	24 »	8.53	3.67
0.001 — 0.00022	3 weeks	17.82	6.54
below 0.00022	—	26.07	6.78

We see, therefore, that the first gley loam is especially rich in the finest constituent parts , even richer than the above mentioned level B of the podsol soil. The content of finest constituent parts of the second loam is lower, but greater than that of the level of the podsol soil. Both loams react on litmus paper in a pronouncedly acid manner. In my earlier experiments on the influence of electrolytes on the clay suspensions of these soils it was established that these clay suspensions are not very sensitive to electrolytes : In order to produce coagulation, very strong concentrations of electrolytes are necessary. By the presence of very small quantities of $NaHCO_3$ the influence of the electrolytes is further reduced. The contents of K_2O and Na_2O soluble in hot 10 % HCl were fairly high :

	K_2O	Na_2O
	%	%
I. Clay soil (Kasdanga)	0.505	0.105
II. » » (Sigulda)	0.240	0.065

Also in cold 0.05 n HCl fairly large quantities of the oxide mentioned were dissolved :

	K_2O	Na_2O
	%	%
I. Clay soil (Kasdanga)	0.019	0.032
II. » » (Sigulda)	0.012	0.012

By the filtration of 1 litre 0.02 n $Ca(HCO_3)_2$ through 100 g. soil were dissolved:

	K_2O	Na_2O
	g.	g.
I. Clay soil (Kasdanga)	0.0108	0.0175
II. » » (Sigulda)	0.0020	0.0016

From the data quoted it is to be concluded that the first gley soil, with filtration of $Ca(HCO_3)_2$, will give much greater quantities of $NaHCO_3$ in the filtrate than will the second, and at the same time filtration through the first soil will also proceed more slowly; the experiment has confirmed this.

In Illustration 95 the results of a few experiments with the second (II) gley soil during the first 23 days are graphically represented.

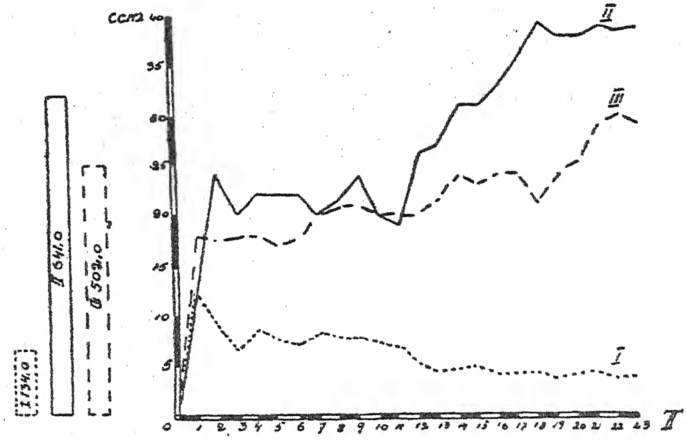

FIG. 95. — Experiments with gley loam (II) from Sigulda.

I. .... Distilled water.
II. ———————— 0.02 n $Ca(HCO_3)_2$ solution.
III. --------------- 0.012 n $CaSO_4$ solution.
Left = Total quantity of the filtrate.

The permeability for distilled water was at the beginning pretty good, but after 23 days it fell to 4 ccm. per day. In the further course of the experiment this quantity became smaller, and after 6 months it amounted to only about, 0.3 ccm. per day.

The permeability for $CaSO_4$ and particularly for $Ca(HCO_3)_2$ was much greater, but if, after these salt solutions, the experiment

was continued with distilled water, then the permeability was reduced very gradually, especially after $Ca(HCO_3)_2$, so, for example, for the next 11 days the quantity of filtrate after $Ca(HCO_3)_2$ amounted to 259 ccm., and after $CaSO_4$ to 90 ccm. The permeability of the clay soil was considerably increased by $Ca(HCO_3)_2$. It is to be assumed that in this case the $Ca^{\bullet\bullet}$ ion had operated which was absorbed by the soil and had thereby altered the qualities of the soil. This conclusion is confirmed by the further series of experiments, the results of which are represented in Illustration 96. In this series of experiments the gley soil from Sigulda (II) was used, from wich the lime-marl was removed (Line 1). The gley loam was several times throughly mixed with $Ca(HCO_3)_2$ solution, the solution poured off every time, and the gley loam afterwards dried and pulverized anew. By this treatment the quantity of absorbed K and Na was reduced, which in this loam generally is not very great. The original, unchanged gley loam from Sigulda (line 2) serves for comparison. For the first 3 days distilled water was filtered. In the sample in which the lime-marl was removed (L 1) this filtration proceeded better. After 3 days, instead of distilled water, gypsum solution was used. The filtration of this solution also proceeded better through the first loam, although the difference was not great. From the 16th day onwards, instead of gypsum solution, 0.02 n $Ca(HCO_3)_2$ solution was used. With this solution the difference was very great: the permeability of the first gley soil increased very quickly, the permeability of the second soil acid decreased strongly at first, then increased again, and not until about two months after starting the experiment did the differences equalize. Three months

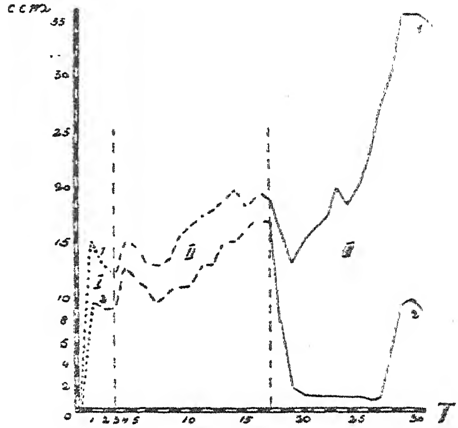

FIG. 96. — Experiments with gley loam from Sigulda.

No. 1 = lime-marl removed, No. 2 = natural clay loam.

I. .... Distilled water.

II. -------------- Continuation of the experiment with $CaSO_4$ solution.

III. ———— Continuation of the experiment with $Ca(HCO_3)_2$ solution.

after starting the experiment a 0.01 n $Ca(OH)_2$ solution was used instead of $Ca(HCO_3)_2$. With this solution the quantities of filtrate fluctuated very little during the whole course of the experiment, the permeability for the first gley soil amounted to 15-20 ccm. per day, for the second (natural) 8-12 ccm., with which the greatest quantities were obtained at the end of the experiment, after 7 months.

In Illustration 97 the results of the experiment with both natural

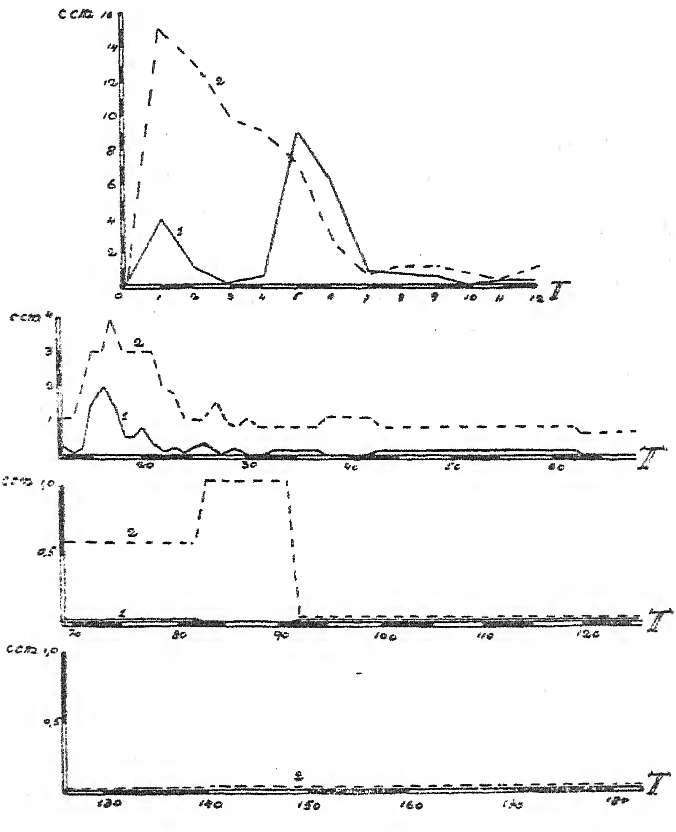

FIG. 97. — Permeability of the Gley soils for $Ca(OH)_2$ solution.

I. ———— Gley loam from Kasdanga; the permeability stops completely after 36 days.

II. -------- Gley loam from Sigulda; after 91 days the permeability is very small.

clay soils are put together, with which from the beginning ($Ca(OH)_2$ solution was used. The permeability did not increase greatly in either

of the soils examined, not even at the beginning: the highest quantity of filtrate in the clay from Kasdanga amounted to 9 ccm. (5th day), in the clay from Sigulda 15 ccm. (1st day). Afterwards the permeability decreased, and in the sample from Kasdanga filtration ceased altogether after 60 days; in the sample from Sigulda the permeability after 90 days amounted to about 0.2 ccm. per day. There was no $Ca(OH)_2$ present in the filtrate, it being completely absorbed by the soil.

With the II. Gley soil from Sigulda thorough examinations were carried out with various concentrations of $NaHCO_3$. The gley soil showed itself very sensitive to even very weak concentrations of $NaHCO_3$: the permeability sank greatly, especially at the beginning, and the finest constituent parts of the soil showed in the filtrate. In a few cases the permeability afterwards increased again, which can be seen from the following data:

TABLE VI. — *Gley loam from Sigulda, quantities of filtrate in ccm.*

	The first 20 days	The next 6 days
1. Distilled water	131	0.8
2. $NaHCO_3$ 0.001 n	55	8.5
3. » 0.003 n	59	10.0
4. » 0.0001 n	79	29.0
5. » 0.00003 n	26	0.4
6. » 0.00001 n	50	12.5

Experiments were also carried out with higher concentrations of $NaHCO_3$. With these it was established that by 0.1 n $NaHCO_3$ solutions very great quantities of organic matter and $Fe(OH)_3$ were washed out; the filtrate was dark brown. With lower concentrations of 0.01 n much less organic matter is present in the filtrate. With these, however, mineral matters are strongly washed out, not only amorphous and colloidal, but also finely crystallized. The quantities of filtrate are very small. With the gley soil II from Sigulda experiments were carried out regarding the influence of the structure of the soil on permeability, for which particles of soil from 1-2 mm. diameter were taken from the pulverized soil, but the finer constituent parts were granulated. With this the permeability increased very strongly, but the parallel determinations gave very varying results; the variations were much greater than in the corresponding experiments with gley loam pulverized and granulated through a 1 mm. sieve. The

particles dissolved very soon, especially under the influence of the distilled water and the $NaHCO_3$ solution. In 15 days the following quantities of filtrate were obtained:

TABLE VII. — *Gley loam from Sigulda. Soil particles* 1-2 *mm. diameter.*

	I.	II.
	ccm.	ccm.
1. Distilled wafer	343	515
2. 0.01 n Ca $(OH)_2$	1220	1990
3. 0.01 n $CaSO_4$	719	1410
4. 0.00003 n $NaHCO_3$	118	57

The greatest quantity of filtrate per day, amounting to 192 ccm. was obtained with $Ca(OH)_2$ solution. It is of interest that in this experiment also the permeability was greatly reduced by the very weak concentration of $NaHCO_3$ of 0.00003 n. In proceeding further, the filtration ceased completely. Experiments were also carried out with low concentrations of $NaHCO_3$, with which a distinctly retarding influence was exerted by a 0.00001 n $NaHCO_3$ solution; the influence of still smaller concentrations, however, was no clearer.

The results of the experiment with the clay loam from Kasdanga are represented in Illustration 98. The permeability of this loam

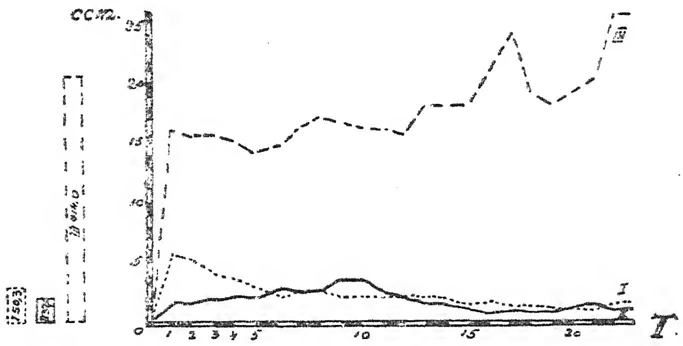

FIG. 98. — Experiments with Gley loam from Kasdanga.

I. .... Distilled water.
II. ———— 0.02 n $Ca(HCO_3)_2$ solution.
III. -------------- 0.12 n $CaSO_4$ solution.
Left = Total quantities of filtrate.

was greatly reduced by $Ca(HCO_3)_3$ solutions. The filtration of the same proceeded even more slowly than that of the distilled water. In

the filtrate of these solutions direct $NaHCO_3$ and even Na_2CO_3 could be determined, which can also be assumed as the main reason of the slow filtration. The permeability for gypsum solution was pretty good, but after a longer time — several months — this fell also here to 4-6 ccm. per day. With distilled water on the first day of the experiment there was only obtained 5.5 ccm. of filtrate ; the permeability was afterwards lower, after about a month it amounted to only 1 ccm. per day, and after 2 months the filtration ceased completely.

On account of these qualities of the gley loam from Kasdanga, and also on account of its high content of the finest soil particles, and its great quantities of absorbed $Na^{\bullet}$ ions, I have again examined the permeability of the loams mentioned for solutions which at the same time contain $CaSO_4$ and $Ca(HCO_3)_2$ in varying proportions to each other. As basic solutions 0.012 n $CaSO_4$ and 0.02 n $Ca(HCO_3)_2$ were used. After 40 days the following quantities of filtrate were obtained :

TABLE VIII. — *Permeability of the gley loam from Kasdanga.*

Used for filtration	Quantity of filtrate in 40 days in ccm.
1. 0.024 n $CaSO_4$	299
2. 0.012 n »	310
3. 90 % 0.012 n $CaSO_4$ + 10 % 0.02 n $Ca(HCO_3)_2$	500.4
4. 70 % » » + 30 % »	298
5. 50 % » » + 50 % »	839.5
6. 30 % » » + 70 % »	528
7. 10 % » » + 90 % »	234
8. 0.02 n $Ca(HCO_3)_2$	219.7
9. 0.01 n »	47
10. 0.005 n »	74.9

The permeability was much increased if the gypsum solution at the same time contained $Ca(HCO_3)_2$, although the permeability for 0.01 n $Ca(HCO_3)_2$ solution was very small. After 40 days all solutions were replaced by 0.01 n $Ca(OH)_2$ solutions, and the experiments continued. On the next day $Ca(OH)_2$ could only be indicated in the filtrate in tube No. 3, through which previously 90 % gypsum and 10 % $Ca(HCO_3)_2$ were filtered ; the quantity of filtrate here rose quickly to 40 ccm. per day and kept at this height for about 5 months running. After 5 months distilled water was used instead of lime

water, and with this the permeability was again reduced. I still continued this experiment for another year, but even at the end of the experiment the permeability was fairly strong, the quantity of filtrate fluctuating between 8-9 ccm. per day.

The experiments with all the other test tubes of the same series were also continued for 18 months, but $Ca(OH)_2$ appeared in the filtrate only in 2 other tubes : in tube No. 2 after 45 days from the beginning of the $Ca(OH)_2$ filtration, and in tube No. 5 after 3 months, but the permeability was here only slightly increased. The permeability of the last 3 tubes was very low, and in tube No. 9, through which 0.01 n $Ca(HCO_3)_2$ solution was previously filtered, the filtration very quickly ceased completely.

The last series of experiments show that the permeability of a few gley loams can be strongly raised by solutions which contain at the same time $CaSO_4$ and $Ca(HCO_3)_2$. The influence of the gypsum in hindering the formation of $NaHCO_3$ and in helping the washing ont of the absorbed $Na^{\bullet}$ ions was here very obvious, whereas by the $Ca(HCO_3)_2$ the content of $H^{\bullet}$ ions in the soil that is, the acidity of the soil is reduced.

In the district of Hasenpoth, whence the last sample of gley loam (Kasdanga) comes, the liming of the soil with meadow or orginal lime has already been known for a long time, and has given good results pretty quickly. The results have only been rather indefinite with gley soils, which here showed an acid reaction to litmus paper. In these cases the application of gypsum is necessary for the improvement of the qualities of the soil, as is shown by the experiments carried out.

Experiments with n (5.85 %) *NaCl solution.*

The results of these experiments differ very much from the others, it is therefore fitting to consider them separately. The experiments were carried out with the six most important samples of soil which were also used in the earlier experiments. The concentration of NaCl used was strong, 1.0 normality, which in all the soils examined produced coagulation of the finest constituent parts of the soil. The earlier experiments showed that by 0.2 n salt solution the clay suspensions of the acid soils were coagulated, whereas coagulation of the clay suspensions of the marl loam was already brought about by 0.04 n solution.

Illustration 99 shows the results of the experiments with the three main levels of the Podsol soil. The permeability for NaCl in solution was smallest in the marl loam, followed by level A; level B has the greatest permeability, however, although even here in the first few days 15-19 cm. per day was not exceeded, which amounts are much smaller than those of the experiments with $Ca(HCO_3)_2$ and $CaSO_4$ solutions. From the 8th day onwards we see strong and steep reduction of the permeability; the line resembles that obtained by D. J. HISSINK 4.) in his experiments with distilled water after previous filtration of the common salt. After 8 days, in my experiments, I loosened the soil in the test tubes with copper wire about 1 mm. thick, but continued the filtration of the normal NaCl solution. Such loosening of the soil had no injurious effect on the filtration of the $Ca(HCO_3)_2$, $CaSO_4$ solutions and the distilled water in the above experiments, but with NaCl the influence was very great. From this it is to be seen that common salt solutions, even in strong concentrations, cause alterations in the qualities of the soil. It is characteristic that after the loosening of the soil the permeability of level A was the greatest, then followed that of level B, and it fell greatly in the marl loam of level C, which here also was not helped by the high contents of $CaCO_3$. Here the filtrate through the marl loam was very alkaline.

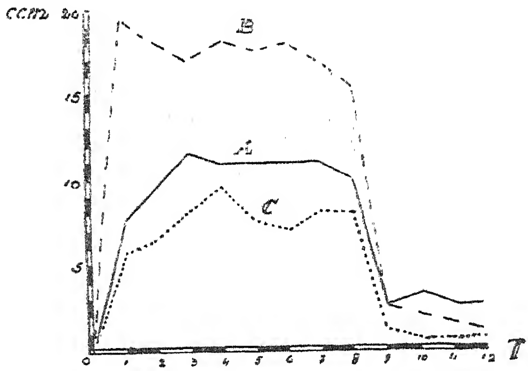

FIG. 99. — Experiments with n NaCl = solution with levels A, B and C of the Podsol soil (C = rubble loam).

It may be taken that in this experiment the circumstance of the absorbed soil cations towards Na and hydrolytic decomposition is of the greatest importance. It must be taken into consideration that the reaction of the first two levels is acid, and here, under the influence of NaCl, small quantities of HCl appear. If other salts are also present in the solution, the HCl, even in very small concentrations, assists coagulation. According to GEDROIZ (5) H_2SO_4 has a coagulat-

ing effect even in concentrations of 0.000075 normality. The action of common salt on marl loams might be quite otherwise. As an electrolyte with different anion and cation, NaCl has here raised the electrolysis of the $CaCO_3$. In the solution might form certain quantities of $OH^{\bullet}$ ions, perhaps even NaOH, whose influence on the increase of dispersiveness is particularly great. The quantity of filtrate through marl loam only amounted to 60 ccm. in the first 8 days; it is difficult to suppose that NaCl could exchange even greater quantities of $Ca^{\bullet\bullet}$ for $Na^{\bullet}$.

The results of simultaneous experiments with gley loams are represented in Illustration 100. It must be pointed out here that the permeability of the very acid I. gley loam from Kasdanga, which is rich in the finest constituent parts, altered very little after 8 days from the loosening of the soil; on the other hand the permeability of the II. gley loam from Sigulda was already reduced a day before the loosening, to fall still more strongly after the loosening. Thə permeability of the neutral, upper level from Kauzmünde was already reduced after 7 days. The reduction was especially great, however, after the loosening of the soil (8th day). The experiments carried out show that in comparison with very weak $CaSO_4$ and $Ca(HCO_3)_2$ concentrations, the common salt as such greatly reduced the permeability, the reduction being much greater, and proceeding more quickly in soils carrying $CaCO_3$ than in acid soils. As under the influence of the NaCl the content of absorbed $Na^{\cdot}$ ion is greater, it is obvious that in the further course of the experiment, and particularly on filtration of $Ca(HCO_3)_2$ the results can only be relative. We have already seen that in the experiment with gley loam from Kasdanga, which, with the filtration of $Ca(HCO_3)_2$, from 100 g. soil gave

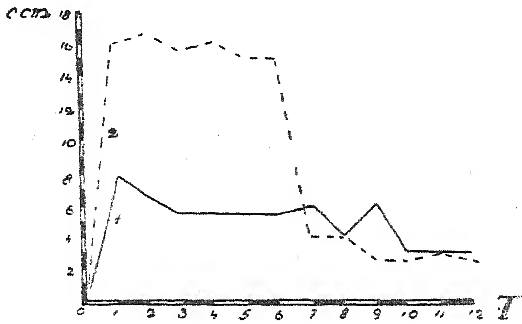

FIG. 100. — Experiments with n NaCl solution in Gley loams.

1. ———————— Gley loam from Kasdanga.
2. - - - - - - - - Gley loam from Sigulda.

to the filtrate 0.0108 g. Na_2O. In the filtration experiments this gley loam with $Ca(HCO_3)_2$ gave smaller quantities of filtrate than with distilled water.

VII. — General conclusions.

The results obtained can be summarized briefly as follows:

1. Great fluctuations of permeability (quantities of filtrate per day) could be observed. In sandy soils the permeability may fall, in the conditions of the experiment, to 0.1 ccm. per day from 2 litres, in loam and gley soils it fluctuates from 0-200 ccm. per day. *The mechanical composition of the soil* offers only a small clue to its permeability

2. The fluctuations of permeability are greater in the loam soils the more these contain finest particles of such a size of grain as are not deposited in 3 weeks after raising the degree of dispersiveness. The fluctuations of permeability of those soils, which contain few grains of this arrangement of size, as for example level A of the Podsol soils, are relatively small, but the permeability is also small even under the action of electrolytes.

3. The permeability is in time considerably reduced by distilled water, in acid soils filtration ceases completely after a few months, as also in the neutral humus level; in marl loam, however, it is only reduced, and still goes on after 1 to 1 ½ years from the beginning of the experiment. The explanation is to be sought in the combinations which are released from the soil by water: in acid soils the $Na^{\cdot\cdot}$ ion has the first place, but in the marl loam the $Ca^{\cdot\cdot}$ ion. If before the experiment the acid soil is neutralized, and $Ca(OH)_2$ filtered through it, then the filtration of the distilled water proceeds much better, and does not cease even after a few months.

4. The filtration of water containing greater quantities of CO_2 proceeds much better than that of distilled water. With that the permeability of marl loam with high $CaCO_3$ contents is particularly increased; in acid soils the difference is smaller, but is very noticeable if the CO_2 content reaches 0.5 g. to the litre.

5. The permeability for 0.02 n $Ca(HCO_3)_2$ solution is very different, and is very greatly influenced by the absorbed $Na^{\cdot}$ ion content of the soil. The permeability of the marl loam is very good for this solution, if there is still no podsol soil developed on it, or if it is taken from deeper levels. The permeability for this solution is

also good in level B of the podsol soil, whilst the permeability of the upper level of the acid soil is pretty small, which may well be explained by the strong absorption of the $Ca^{\bullet\bullet}$ ions. Very great differences of permeability for this solution are also observed in the gley loams. The permeability of the gley loam from Kasdanga, which contains considerably more absorbed $Na^{\bullet}$ ion, is very small, even smaller than for distilled water. If before the experiment the lime-marl is removed and at the same time the absorbed $Na^{\bullet}$ ion partially removed, then the permeability is distinctly greater.

It must also be noted that the Ca $(HCO_3)_2$ solution also contained free CO_2, with which the content of CO_2 showed great fluctuations, which might also influence the permeability.

6. The permeability for gypsum was fairly similar to that for $Ca(HCO_3)_2$, except for the marl loam on which podsol soil had developed, and the gley loam from Kasdanga; these are soils which contain great quantities of absorbed $Na^{\bullet}$ ion. The permeability was also good for gypsum in these soils, because in the exchange reaction not much $NaHCO_3$ could arise.

7. Especially great influence on the raising of the permeability in very acid gley loam (from Kasdanga) was exerted by such solution as contained $CaSO_4$ and $Ca(HCO_3)_2$ together, and therefore considerably more gypsum than hydro-carbonate of calcium. *The permeability of the very bad gley loam was in this case very greatly increased.*

8. The permeability of the neutral soils is very greatly raised by $Ca(OH)_2$ and remains very great for some months. The permeability of the very acid soils, on the contrary, is quickly reduced, and relatively quickly the filtration ceases completely. Where the permeability of the soil in the foregoing experiments has been found very low, it is not always possible to raise it to an appreciable extent by the application of $Ca(OH)_2$ solutions.

9. The permeability is considerably reduced by $NaHCO_3$ solution of even very weak concentration. If the soils contain no $CaCO_3$, then the finest constituent parts are much washed out; in such cases the permeability is sometimes even increased, but after a few days is again reduced and filtration ceases completely. Level A of the podsol soil, which contains very small quantities of the finest constituent parts, is not very sensitive to $NaHCO_3$. The negative nfluence of $NaHCO_3$ is greatest in gley soils with which the structure suffers most, if the gley soil contained any before the experiment.

An injurious influence is exerted even by concentrations of 0.00003 n $NaHCO_3$, i. e., less than 0.003 g. to the litre.

It is to be expected that even very diluted solutions of ammonia may have a retarding action on the permeability, especially those of the marl loams and clay soils. The degree of dispersiveness of the marl loams is already notably increased by very diluted ammonia solutions such as 0.0003 n, and the decomposition of the carbonate of calcium is even reduced by 0.0001 n ammonia solution.

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A CONTRIBUTION TO THE KNOWLEDGE OF THE DETERMINATION OF SOIL FERTILITY.

The life of micro-organisms in the soil is the result of the phenomenon of assimilation in its entirety. The vital processes are characterized by the surrounding of the chemical molecules in the living being and by a constant exchange between latent and kinetic energy. The carbo-hydrates contained in the soil, as also the nitrogenous organic substances, are assimilated, and exchange takes place in the cells of the carbo-hydrate and albumen. A part of the carbon and nitrogen is used to build up new living molecules, but the greater part of the carbon, in the form of carbohydrates and albumen, gradually disappears in the process of oxidation.

The decomposition products, being poisonous, are rejected by the cells, or deposited in a harmless form. The quantity of carbon-dioxide exhaled by the soil when there is free admission of air, shows us the living energy of the bacteria, as does also the easy decomposition of the organic substances in the soil. The heterotrophes find in the organic substances not only a source of energy for their breathing process, but also carbon and nitrogen food sources for building up new living material.

In the bio-chemical analysis of the soil, the concentration of hydrogen ions in the soil must always be kept in view. The absorbent, unsaturated soils of humid districts, which are rich in humus and colloidal clay, usually show an acid character. The following data plainly prove how both the number of the vegetative spores, of the bacteria in the soil, and also the quantity of carbon-dioxide exhaled by the soil, are influenced by the active acidity of the soil. The experiments were carried out for 24 days in soil with 20 % water at 20° C.

From these data it can be seen how important it is to observe the concentration of the hydrogen ions of the soil when making the experiment. Soils, the acidity of which rises to pH = 4.7 - 4, are very rich in easily decomposed organic substances, but the acidity is so great that the bacteria cannot develop sufficiently.

TABLE I. — *Influence of the acidity of the soil on the number of bacteria and on the quantity of carbonic acid in the soil.*

pH	Carbon contents of the soil in dry substance	Average quantity of carbon-dioxide exaled by 1 kg. of soil in 24 hours	Number of vegetative spores of the bacteria in 1 g. of soil
	%	mg.	Millions
7.2	2.58	85	78
6.9	2.17	90	76
6.6	1.93	66	52
5.8	2.64	48	20
5.3	1.87	22	16
4.7	2.88	9	8
4.0	3.16	5	6

With a concentration of hydrogen ions pH = 4, the number of bacterial vegetative spores varies, between 4 - 6 millions per 1 g. soil.

By the addition of calcium carbonate, namely, from 25-50 g. per 1 kg. soil, the acidity is paralysed, and the bacteria then find in the organic substances a good source of energy. The organic acids then no longer hinder bacterial assimilation. I append an example of this:

The peat soil of Sadskâ, which is not rich in ferro- and ferri-sulphates, has an acidity of pH = 4.2. This soil, with 20 % water, exhaled 8 mg. carbon-dioxide per 1 kg. in 24 hours at 20° C. Following the addition of calcium carbonate, namely, 50 g. per 1 kg. of soil, the quantity of carbon-dioxide exhaled under the above conditions rose after 30 days to 21.4 - 27 mg.

All organisms in the soil, require, for the construction of new living substances all the other biogenous elements in addition to carbon, which is always contained in the organisms up to 42-48 %. The form in which the biogenous elements, particularly nitrogen, are offered to the soil is not unimportant. In arable, meadow, wood and garden soils, types of bacteria predominate which either assimilate nitrogen from easily soluble substances containing nitrogen, or such as give the preference to ammonia salts, or bacteria which prefer nitrates. The rise in the intensity of breathing of the bacteria in various kinds of soil following the addition of organic or inorganic combinations containing nitrogen, depends on the character of the bacteria which predominate in the soil concerned. We have undertaken experiments in our experimental fields, also in the various arable and wood soils of Czecho-Slovakia,

on the effect of mineral, nitrogenous manures on the breathing intensity of the soils. I give here only a few examples, in order to show the different effects produced by manuring with sulphate of ammonia and Chili saltpetre on loamy, sandy soils, loamy lime soils, clay soils and humus soils.

The fact certainly remains that the application of mineral, nitrogenous manures increases the breathing intensity of the microorganisms of the soil, particularly in such soils as contain easily decomposed organic substances in sufficient quantity.

TABLE II. — *The quantity of carbon-dioxide produced in 24 hours from 1 kg. soil with 20 % water, at 20° C., and with 20 l. of air being passed through. In mg.*

Kind of soil	Unmanured soil	Soil manured with 80 kg. nitrogen per hectare in the form of *sulphate of ammonia*	Soil manured with 80 kg. nitrogen per hectare in the form of Chili saltpetre
	mg.	mg.	mg.
Loamy sandy soil	15.5	30.6	35.9
Loamy lime soil.	38.3	49.6	58.3
Clay soil	27.5	32.4	35.8
Humus soil	32.6	36.6	44.2

From these data it can be plainly recognized what a great increase of breathing capacity the soil, especially the loamy lime soil, has acquired from the addition of sulphate of ammonia and sulphate of sodium. The breathing intensity was also raised with loamy sand soil and clay soil. The least effect was shown in humus soil.

The contents of carbon in the dry substance amounted to:

in loamy sandy soil.	1.04 %
» loamy lime soil	1.16 %
» clay soil.	1.53 %
» humus soil	3.28 %

By the constant use of mineral, nitrogenous manure, the humus substance in the soil is broken up to carbon-dioxide, and so the soil always suffers a shortage of carbon. The same appearance was shown on the application of superphosphates. The experiments were carried out in the same manner, and with the same

soils as in the experiments with nitrogen, except that 60 kg. of phosphoric acid in the form of superphosphate were used per hectare. In the following table the breathing intensity of the manured and unmanured plots of the various soils is quoted:

TABLE III. — *The quantity of carbon-dioxide, in mg., produced on an average in 24 hours from 1 kg. soil with 20 % water, at 20° C., and with 20 l. of air being passed through.*

Kind of soil	Unmanured soil	Soil manured with 60 kg. phosphoric acid in the form of superphosphate
Loamy sandy soil	15.8	19.4
Loamy lime soil	39.6	43.7
Clay soil	27.5	30.8
Humus soil	32.6	45.6

These data show that even with the addition of phosphoric acid soluble in water, an increase in the breathing capacity of the soil is effected, and this increase is greatest in the humus soils. Then follow loamy lime soil and sandy soil.

We have found in our laboratory experiments, and those on the experimental fields, that the increase in the production of carbon-dioxide with the use of stable manure is effected on one side by the native active bacteria of the stable dung, and on the other by the supply of its organic easily decomposed substances. This raising of the breathing intensity depends not only on the number of bacteria, but also on the degree of capacity for decomposition of the organic substances contained in the stable dung. In order to produce an increase of activity in the bacterial world in the soil the food molecules must split up into easily oxidizable decomposition products.

The stable manure must be so treated that it brings about a certain fermentation in the sense of oxide reduction. The decomposing processes of the organic substances are occasioned by the intermolecular respiration. *The action of the stable manure depends not only on the quantity used, but on the quality of the decomposable organic substances and on the activity of the bacteria.*

Even small quantities of stable manure can effect a notable increase of the respiration processes of the microorganisms. On

our experimental fields we have carried out experiments regarding the increase of carbon-dioxide production of the soil by stable manure. The soil of the experimental fields was a good loamy soil, which, calculated on the dry weight, showed a carbon content of 1.8 % and a calcium carbonate content of 0.3, and in 1 g. contained 46 million bacterial vegetative spores. The unmanured soil exhaled on an average 4.02 g. of carbon-dioxide per square metre in 24 hours. On the application of 200 quintals to the hectare of well treated stable manure containing 40 kg. nitrogen, an average of 5.03 g. carbon-dioxide per square metre in 24 hours was exhaled from the soil by diffusion. The experiment lasted 15 days. Air was conducted through the bell 6-8 hours daily.

On the application of 400 q. stable manure per hectare containing 80 kg. of nitrogen, 6.59 g. carbon-dioxide per square metre were exhaled in 24 hours by the same methods of experiment.

In order to prove that stable manure, in its action of increasing the production of carbon-dioxide, cannot be replaced by nitrogenous fertilizers, we have at the same time carried out manuring experiments with Chili saltpetre. We again used, as in the experiments with stable manure, 80 kg. nitrogen per hectare. After 15 days observation 5.58 g. carbon-dioxide per square metre was produced in 24 hours.

With the control plots, where no stable manure and no nitrogenous fertilizer was used, the production of carbon-dioxide amounted to 4.02 - 4.01 g. per square metre in 24 hours.

The experiments were proceeded with steadily for 30 days after the manuring with stable manure, urea or Chili saltpetre commenced, and were carried out in the month of September.

By the experiments made, our opinion which we had already expressed in the year 1906 was confirmed, namely, that stable manure is to be regarded as the best producer of carbonic acid. It was certainly of great interest to learn how green manuring affects the carbon-dioxide production of the soil. In these experiments we again used the same soil as in the experiments with stable manure, and made use of so much organic substance of *Lupinus luteus*, that there was again added the soil 80 kg. nitrogen per 1 ha. in the form of green plant manure. The green plant substance of *Lupinus luteus* was superficially ploughed into the loamy soil, and after 30 days the carbon-dioxide production of the soil was ascertained. By a 10 days' analysis it was determined that *on*

an average 5.03 g. carbon-dioxide per square metre of soil was produced in 24 hours.

In the experiments with stable manure we ascertained that, after the addition of 80 kg. nitrogen per hectare, in the form of stable manure, there was, after 15 days' observation, an average production of carbon-dioxide by the soil of 6.59 g. per square metre in 24 hours. By manuring with stable manure, therefore, the respiration intensity obtained is much greater than by green manuring, namely, by 1.56 g.

According to our investigations, every cultural plant possesses its own specific characteristics in the processes of photosynthesis and assimilation. This is to be traced to the dissimilar working efficiency of the cells containing chlorophyll and the cells without chlorophyll of the various plant organisms. Only now can we form a conception of the enormous quantities of carbon-dioxide assimilated out of the air under the influence of sun by means of carbon-dioxide reception. If during the development of the cultural plants the climatic vegetation factors are at a minimum, then of course the photo-synthesis sinks, and nitrogen, phosphorus, chlorine, sulphur, potassium, magnesia, aluminium, iron, etc. cannot be used so largely for the synthesis of cell building as they can when the vegetation factors are at their highest. On the climatic vegetation factors, therefore, depends the whole assimilation of the carbon-dioxide from the air, as also the resorption of the mineral foodstuffs out of the soil, and therefore the total working efficiency of the plant. In our case 96.8 q. carbon, 1.68 q. nitrogen, 2.20 q. oxide of potassium and 0.6 q. phosphoric anhydride were resorbed and used for the synthesis of cell building. For every 100 kg. of the assimilated carbon there escaped barely 1.74 kg. nitrogen, 2.27 kg. oxide of potassium and 0.62 kg. phosphoric anhydride. If the assimilation of carbon falls, then naturally the nitrogen, phosphorus, potassium etc. will not be sufficiently utilized, and will remain for the greater part in the soil for future vegetation. The resorption of the mineral food material from the soil is connected therefore in a certain way with the building and reconstruction of the cell contents.

It is a fundamental fact that under the natural conditions of growth, with the present state of the cultivation of the soil and the culture of plants, the carbo-hydrate factor is generally at a minimum. It has already been plainly prove by the investigations

of FODOR, WOLLNY, STOKLASA, BORNEMANN, FISCHER, REINAU and LUNDEGARDH that by the respiration of the soil an enrichment of carbonic acid is effected in the ground layer of the atmosphere. The carbon-dioxide, which escapes from the soil by diffusion, owes its origin to the respiration of the *Auto-* and *Heterotrophes* in the soil. The results of our experiments, obtained 30 years ago, plainly show that a great deal depends, on whether the soil is well cultivated mechanically, manured and tilled, or not. Further, it is not a matter of indifference with what genus of cultivated plants the soil is planted. We were able to observe greater respiration energy of the micro-organisms in soil plated with beetroot and potatoes, than with soils set with cereals. The ascertained degree of air capacity, with all the soils investigated by us, stands intimately related to the quantity of carbon-dioxide exhaled. The greater the air capacity of the soil, the greater the respiration intensity of the micro-organisms in the soil. The determination made by us 30 years ago of the life activity of the *Auto-* and *Heterotrophes* in the soil, by measuring the quantity of carbon-dioxide exhaled, is a reliable method for ascertaining the intensity of the process of exchange of matter of the *Auto-* and *Heterotrophes* in a given quantity of soil. The quantity of carbon-dioxide produced in a given time, at a given degree of humidity, and at a fixed temperature, gives us an exact picture of the size and the mechanics of the physiological combustion. The respiration intensity shows that there is present in the soil not only a considerable quantity of active bacteria, but also decomposable organic substances. By taking into consideration all the factors just mentioned, the quantity of carbon-dioxide produced on an average in 24 hours from the micro-organisms of various kinds of soil gives us a means of comparison for the output of the micro-organisms in the soil. We find that the respiration intensity of the various micro-organisms varies extraordinarily, and is dependent on different vegetation factors. The quantity of exhaled carbon-dioxide is an indicator of the fertility of the soil. On the basis of our observations, we can maintain that with soils of a different degree of fertility, the quantity of carbon-dioxide exhaled per 1 kg. soil in 24 hours, with 20 % water contents, and at 20° C., varies tremendously. The results obtained from observations and analyses, extending over many years, on arable soils of Bohemia and Moravia, are put together in the following table:

TABLE IV. — *Quantity of carbon-dioxide exhaled from the soil, as a measure of fruitfulness.*

Nature of soil	Quantity of carbon-dioxide per 1 kg. soil in 24 hours	Quantity of carbon-dioxide per hectare in 200 days from a layer 30 cm. deep	Carbonic acid, reckoned on the lower limit of CO_2 production at the time
	mg	q.	q.
Fruitful soils which bear, per hectare 25-30 q. corn, 350-400 q. beet	60 — 120	480	131.08
Less fruitful soils	30 — 60	240	65.54
Unfruitful soils	15 — 20	120	32.77

The carbon-dioxide is in part exhaled from the ground by diffusion, partly absorbed by the water and the carbon is redeposited in the soil in the form of bicarbonates.

In any case the quantities of carbon-dioxide produced from various kinds of soil, which escape from the soil by diffusion, are of interest. According to our investigations, when the temperature of the soil planted with various cultures is 13 - 17° C., this amounts to:

TABLE V. — *Carbon-dioxide production of various kinds of soil.*

Kind of soil	Carbon-dioxide per 100 kg. in 24 hours	Carbon-dioxide per ha. in 200 days	Carbonic acid production in
	g.	q.	q.
Fruitful soils	6 — 8	120 — 160	32.73 — 43.63
Not very fruitful soils	4 — 5	80 — 100	21.82 — 27.27
Unfruitful soils	2 — 3	40 — 60	10.91 — 16.36

We see what extraordinary quantities of carbon-dioxide are produced from the soil in 200 days, and what fundamental importance the respiration of the soil must have for the nourishment of the cultural plants. The plants are not exclusively dependent on the carbon-dioxide contents of the free atmosphere, but the leaves also assimilate the carbon-dioxide escaping from the soil, and so a great addition of carbon is made possible for the plant organisms.

Of course, an increased respiration of the soil means also an increased demand for a store of humus in the soil, for which the organic residue of the individual kinds of our cultural plants does

not suffice. The total quantity of stubble and root remains which are left in the fields after the harvest, although considerable, are not sufficient.

TABLE VI. — *Stubble and root residue left per hectare.*

Kind of plant	Dry weight of the plant substance	Carbon content	Carbon
	kg.	%	kg.
Rye	4328	44.8	1938.94
Wheat	4316	49.7	2145.05
Oats	4285	49.1	2103.93
Barley	4894	50.6	2449.93
Red Clover	9163	46.9	4297.44
Lucerne	11432	45.2	5167.26

These figures show plainly the quantities of carbon which remain in the stubble and root residues of the individual cultivated plants, and how important it is to put clover and lucerne in the crop rotation. In all countries in which clover and lucerne are little cultivated, as for example in some districts of Czechoslovakia, Poland, Jugoslavia, etc., the carbon content sinks, and even manuring with phosphoric acid and potash cannot be utilized with full effect. By the influence of the organisms in the soil the withered root system is gradually decomposed, the celluloses, pentosanes, etc. hydrolysed and further decomposed (1).

It must in any case be taken into consideration that by the bio-dynamic processes of the micro-organisms in the soil, a certain quantity of carbon is collected in the vital layer of the soil, though here it is only a question of a few hundredweights per year. It has so far been impossible to determine the exact quantities satisfactorily.

The deeper we penetrate into the knowledge of the processes taking part in the bio-dynamics of the micro-organisms of the soil, the more we get the impression that the micro-organisms in the soil in a certain sense co-operate. This applies particularly to the autochthonal flora according to WINOGRADSKI, and the microbes occurring in the soil in the form of spores, and which only have the opportunity of vegetative growth by alterations in the soil, or under the influence of added inorganic manure, such as nitrate of ammonia, nitrate of potassium, nitrate of soda, calcium-nitrate, sulphate of ammonia, and of organic substances such as

urea, organic plant material and stable manure, also phosphates, as we have already mentioned. The activity of the bacteria, fungi, actinomycetes and protozoa depends mainly on the decomposition of cellulose which is easily decomposed and of lignin which is very resistant to decomposition, because the cellulose represents a very important carbonaceous material for the provision of energy and the exchange of matter of the micro-organisms of the soil. If besides cellulose there are merely small quantities of nitrogenous organic substances in the soil, then the process of decomposition is quite different to that shewn in the presence of large quantities of nitrogenous organic and inorganic substances and easily soluble phosphoric acid. In this case the cellulose is much more energetically decomposed, and the intermediary products formed by the decomposition of th cellulose and the nitrogenous organic substances will serve as valuable material for building up new living molecules of the micro-organisms. SELMAN A. WAKSMAN (2), in his classic work "The soil population", has described these living processes of the bacteria in an excellent manner. When all vegetation factors are present, the vitality of the bacteria rises energetically, and the organic substances are quickly decomposed.

Assuming that the soil contains even 2 % *carbon, then* 1 *ha. of soil, to a layer of* 30 *cm., contains* 80 000 *kg. carbon. If the fertile soil exhales* 40 *q. of carbon in* 200 *days, then, if no replacement of the carbon takes place, the store of carbon in the soil would be exhausted in* 20 *years. The carbon content of the stubble and root residues of our cereals is not sufficient to cover the deficit. The farmer sees here how extraordinarily important it is to keep the carbon ratio constantly in view.*

We are compelled always to introduce organic substances along with mineral manures, because the organic substances in the soil are much more energetically decomposed in the presence of nitrogen, phosphorus, potassium, calcium and iron. By the conveyance of easily decomposable organic substances, and a great number of active, rhizo-spherical bacteria in the form of bacterial manures, the production of carbonic acid is uncommonly increased, the formation of bicarbonates in the soil proceeds very energetically, and the fertility of the soil is raised.

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NOTES AND LITERATURE.

(1) A striking difference is seen in the development of the garden flora on the coasts of Istria and Dalmatia as compared with the French and Italian Riviera. On the French and Italian Riviera a great quantity of stable manure, especially horse dung, is used; in Istria and Dalmatia, on the contrary, relatively very small quantities. On the French and Italian Riviera the soil contains 1.3-2.4 % of carbon and, calculated in dry weight, 40-110 million active bacteria per 1 g. The soil in Istria and Dalmatia contains 0.5-0.6 % carbon, and, calculated on the dry weight, 10-20 million bacteria per 1 g. of soil. The poor results in the cultivation of garden plants on the coasts of Istria and Dalmatia can be explained by the bad heating of the soil in the night. The samples of soil from the French and Italian Riviera, which were taken from a depth of 30 cm., exhaled on an average 70-120 mg. carbon-dioxide per 1 kg. in 24 hours, with 20 % water-content, at 20°C. The soil in Istria and Dalmatia, on the other hand, under the same conditions, exhaled on an average scarcely 30 mg. carbon-dioxide.

(2) Selman A. Waksman: The soil population. *Proc. of the Nat. Acad. of Sciences* (U.S.A.), Vol. 11, No. 8, p. 47.

ON THE DEGREE OF HUMIFICATION OF THE DEAD COVERING OF FOREST SOILS.

The nutrition of trees in the forest depends, to a great extent, on the quantity and the composition of the nutritive matter contained in the superficial layers of the dead matter covering the ground and of forest humus. The organic matter which covers forest soils, contains an abundant reserve of nutritive elements; this absolute wealth, however, has only a very relative importance for them. To get a more precise idea of the quantity of organic matter which the trees can profit by, it would be necessary to determine the proportion of organic matter utilizable by plants. The appearance of the different forms of forest humus originating under different kinds of forest trees demonstrates to us considerable differences in the chemical composition of the organic matter and in its aptitude for being subjected more or less readily to the processes of natural decomposition. To make clear the different degrees of decomposition of the dead covering and humus which is formed under the different species of forest trees, I have tried, in the present paper, to apply a new laboratory method enabling the degree of humification of organic matter to be determined.

By causing a 6 per cent. solution of peroxide of hydrogen to act on forest humus and by boiling the liquid at a moderate temperature, it is possible to render the humified organic matter soluble in water, while fibrous organic substances, such as cellulose and lignin remain intact. According to ROBINSON (1) by the action of oxygenated water the humified matter undergoes oxidation and is brought to a condition of soluble compounds, while the attack on fibrous substances remains negligible.

In the following table the results of my experiments on the humification of the superficial layers of humus and vegetable mould rich in organic matter from the forests of spruce, Scots pine and pedunculate oak in the forest of Jirny near Prague, is summed up. These results are compared with the intensity of nitrification, ex-

(1) ROBINSON, G. W. and JONES, J. O. *Journ. of Agric. Science*, 15, p. 26, 1925.

pressed as difference between the initial content in nitric nitrogen and that after the sample examined had remained for 30 days in a conical phial under laboratory conditions.

TABLE I. — *Forests of spruce, Scots pine and pedunculate oak. Forest of Jirny.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter		Active acidity p H	Nitrogen of nitrates mg. per 1 kg. of dry substance. Difference after nitrification
		in dry substance	in organic matter		
Spruce, 100 years, soil covered with moss.	54.16	12.83	23.69	3.8	— 10.25
Spruce, 90 years, soil covered with moss .	51.20	30.69	59.94	4.8	— 4.37
Spruce, 100 years, open, soil covered with moss.	31.21	20.62	66.07	5.0	— 0.80
Spruce, 70 years, close, soil without vegetation	30.64	21.16	69.04	5.6	+ 4.71
Scots pine, 60 years, veget. moss . . .	22.59	4.16	20.66	3.2	— 6.00
Scots pine, 120 years, veget. moss, grass .	18.39	6.42	34.90	4.2	— 0.50
Scots pine, 100 years, veget. moss, grass underwood of oak 10 years	48.37	30.02	62.06	5.4	+ 3.20
Scotspine, 30 years, veget. grass underwood of oak 20 years	21.01	12.72	60.57	6.2	+ 9.77
Ped. oak, 100 years, veget. moss, grass. .	23.19	11.33	48.86	5.0	— 13.26
Ped. oak, 80 years, open, underwood oak 10 years, veget. grass	34.33	18.49	53.86	5.2	+ 1.96
Ped. oak, 80 years, open, veget. grass . .	52.56	33.00	62.78	5.7	+ 3.75

It is seen from the data in Table I that the proportion of humified matter contained in its entirety in organic matter increases in the cases examined of the humus of spruce, Scots pine and pedunculate oak, with the decreasing acidity of the vegetable mould.

The strongly acid layers of the dead covering under close growing conifers and pedunculate oak hardly produce any nitric nitrogen, with the exception of the more open forests with sweeter humus richer in humified matter, although the intensity of nitrification always remains very low.

Tables II and III include the results of experiments in the forest region of St. Margueritte near *Jindřichiw Hradec* and in the region of *Třemošnice* near Čàslav in Bohemia.

TABLE II. — *Forests of St. Margueritte near Jindřichiw Hradec, Bohemia.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter		Active acidity pH	Nitrogen of nitrates mg. per 1 kg. of dry matter. Difference after nitrification
		in dry substance	in organic matter		
Ped. oak, 80 years with underwood of beech. Soil without vegetation . . .	38.78	32.04	82.62	5.9	43.85
Spruce, 80 years, close. Soil without vegetation	42.49	17.32	40.76	4.1	2.66
Oak, beech, silver fir, spruce. Hartig's felling area, 70 years. Soil without veget.	45.07	24.86	55.16	4.9	14.15
Scots pine, 70 years, without underwood .	81.34	31.39	38.59	4.2	14.03
Scots pine, 60 years, with underwood of beech, 20 years	64.00	35.37	55.27	5.4	21.72

TABLE III. — *Forests of Třemošnice near Časlav in Bohemia.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter		Active acidity pH	Nitrogen of nitrates mg. per 1 kg. of dry matter. Difference after nitrification
		in dry substance	in organic matter		
Spruce, 90 years, soil without vegetation.	52.38	16.28	31.08	4.0	— 9.00
Spruce, 70 years, soil without vegetation.	69.29	29.39	33.88	4.8	12.63
Clearing of spruce forest 2 years after deforestation. Vegetation: — *Epilobium angustifolium*, *Rubus idaeus*, *Deschampsia flexuosa* etc..	34.21	28.13	82.23	5.4	108.03
Beech, 70 years, soil without vegetation .	43.47	22.14	50.93	5.2	0.17
Beech, spruce, Scots pine, 70 years soil without vegetation	36.85	18.34	49.77	5.1	33.40
Hornbeam, young coppice of 20 years.	25.25	17.52	69.27	5.6	99.06
Beech, hornbeam, maple, ash, young coppice of 20 years	18.17	13.25	79.92	6.0	49.87
Beech, maple, hornbeam, ash, high forest of 70 years. *Anemone nemorosa*. . .	28.72	21.94	76.39	6.5	193.98

It appears from the above mentioned experiments (Tables II and III), that the layers of humus in broad-leaved forests generally

show a very considerable degree of humification and at the same time a lively intensity of nitrification.

The acid humus of conifers, exposed to the action of sunlight is more easily rendered soluble than that found under the dense shade of the crowns of the standing trees.

In high forests of Scots pine, the favourable influence of the beech underwood is shown by the greater degree of humification of the superficial layer of humus. The same observation appears from the comparison of close grown forests of conifers with mixed stands composed of broad-leaved species and species with persistent leaves.

ANTONIN NEMEC,
Prague.

Abstracts and Literature.

General.

A New Soil Core Sampler.

POWELL, E. B. (Missouri Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 53-57. Baltimore, Md., 1926.

The author describes a sampler that would take an undisturbed core of soil with the desired dimensions. The sampler consists essentially of two cylinders, one within the other, the outer one being furnished with cutting knives. A diagram of the sampler with a detailed description of its construction and two photographs are given in the article. Anyone especially interested can make arrangements with the Agricultural Experiment Station Columbia, Mo., U. S. A. to secure blue prints and specifications of this sampler. J. S. JOFFE.

Tschermak's Mineralogical and Petrographic Review.

New Series ; Vol. 38 ; 623 pages ; 93 illustrations ; 11 tables ; Published by Hölder-Pichler-Tempski A. G. Vienna 1925.

The 38th volume of this review appears as a special number in honour of the 70th birthday of FRIEDRICH BECK and as such is particularly well got up. Contributions have been sent by a large number of his former pupils, and of them this number contains thirty-five. Most of the contributions deal with mineralogical and petrographic problems, but to a soil-scientist the following will be of particular interest : (1) On the formation of the phosphates of lime in the gault of the Vorarlberg (p. 206-209) ; (2) On the weathering processes in the augite-porphyrites (melaphyres) of the Waldenburg highlands (p. 309-352) ; (3) Structure-statistics (p. 392-423) ; (4) On the numerical treatment of the structural properties of rocks

(p. 479-493) and (5) On the Cenomanian phosphate deposits in the Dnjester districts of Polish Podol (p. 599-609). In article (1) SCHADLER describes the diverse forms of occurrence of the phosphates of lime (phosphorites) in the glauconite sandstones and limestones. In article (5) TOKIERSKI deals also with the phosphates. He describes the geological and petrographic relationships of the Podolian phosphates, and deals also with their chemical composition and their economic importance for Poland. Article (2) of MILCH and ALASCHEWSKI forms a very valuable contribution to the knowledge of the relation between the habit, chemical processes and the changes in mineral composition of weathering rocks. Unfortunately lack of space prevents us from dealing with this most interesting paper in greater detail, but the reading of it can be recommended to every soil-scientist. The same applies to articles (3) and (4) on the structure of rocks which give very valuable suggestions when applied to soils. HELLMERS.

Soil Physics.

On the Mechanical Analysis of Soils containing Heavy Minerals.

MARCHAND B. de C., *South African Journal of Science*, Vol. XVIII, pp. 223-226. Johannesburg, 1922.

In the Transvaal many red loams are derived from basic igneous rocks like norite and diabase, which in some places contain bands of magnetite. Such soils consequently also contain a relatively high percentage of heavy minerals, principally magnetite. The author has examined the fine gravel and sand fractions — where a separation of heavy minerals by THOULET's solution is possible — and has found in the sand as much as 39 per cent. heavy minerals (30 per cent. magnetite).

It is clear that sedimentation and elutriation methods of mechanical analysis would not give a correct idea of the smaller sized fractions of such soils, such fractions no doubt containing also a high percentage of heavy minerals. The author sought after a method for reducing these soils to a common basis, but without success, it being impossible to separate the soil as a whole into heavy and normal particles. MALHERBE.

The Contribution to the Discolloidity of the Soil.

SMOLÍK L. Příspěvek k diskolloidním proměnám v půdách, *Věstník Ceskoslovenscké Akademie Zemědělské*, p. 221. Prague, 1926.

The colloidal state of the soil is not constant. It depends on the action of temperature (freezing) on the different electrolytes (fertilisers) and on ploughing. These factors may modify the total surface and consequently the hygroscopicity which is proportional to it. The variability of the total surface of the soil has been studied in connection with the disthermical influences. The hygroscopicity has been determined as well as the absolute dessication of the soil after RODEWALD-MITSCHERLICH, and the activity of catalase with the apparatus of KOENIG. The author gives a few results:

1) The total surface of the soil particles is a function of the temper-

ature at which the soil was dried. The hygroscopicity of the soil decreases with increase of temperature. Air dried soils shrink about 11-15 % of their surface. This decrease of the active surface is, from a practical standpoint very important, for the production of nutritive substances in the soil after a hot summer. The total surface of soils dried at 50° and 100° is reduced only by about 0.7-5.6 %. With absolute dessication the surface is decreased by about one-fifth for mineral soils, and two-fifths for peat. It seems that the temperature has greater effect on the pectisation of humus than on that of other organic matter.

2) The activity of catalase of the dried soil decreases with hygroscopicity (except at a temperature of 50°).

3) Intermittent frost has little action on the shrinkage of the surface of air dried soils. On the other hand the surface of the moist soil is increased about 4 %. In the case of air dried soils the activity of catalase is decreased by about 3.5 cm^3 oxygen, in the case of moist soils by about 4 cm^3.

4) The leaching of electrolytes, if continued sufficiently (20-27 litres of water for about 150 gms. of soil) causes the peptisation of hydrogels, and the hygroscopicity increases about 10 %. The activity of catalase is also increased. When on the contrary the electrolyte content of the soil is increased, the total surface of the soil is decreased.

5) The variations in the colloidal state, which have begun under the influence of temperature, are only partly reversible, over a short period. AUTHOR.

On the Chemical Changes in Granites under Moors.

BLANCK, E. and RIESER. A. *Chemie der Erde*, Vol. II, part 1, pages 15-48. Jena 1925.

This piece of work is a contribution to the elucidation of the question of kaolin formation. Before dealing with their practical work, the authors review critically all the different views propounded on the formation of kaolin. As the object for their investigation the authors chose "brocken" granite, and their investigations and analyses were not concerned only with the granite, but also with the overlying peat and moor-waters. They investigated also atmospherically weathering granite particles. The results of these investigations are given in numerous analytical tables. The authors conclude that the weathering of the "brocken" granite does not tend in the direction of kaolin, and also that the bleaching of the rock is caused by the sulphuric acid formed. HELLMERS.

Effect of Various Methods of Applying Fertilisers on Crops and on Certain Soil Conditions.

COE DANA G. (Iowa State College), *Soil Science*, Vol. XXI, pp. 7-21. Baltimore, Md., 1926,

Fertiliser applications in direct contact on the ridge or in direct contact in the drill-row with seed are likely to be injurious to the

best germination of the seed. Planters designed with fertiliser attachment for direct contact are not advised for use. In place of direct contact it is recommended to use the methods of "above the ridge or drill row" the "below the ridge or drill row" and the "sides of ridge or drill row" method. J. S. JOFFE.

The Effects of Various Methods of Applying Fertilisers on Crop Yields.

COE DANA G. (Iowa State College). *Soil Science*, Vol. XXI, pp. 127-141. Baltimore, Md., 1926.

This is the second part of a study (see above first part) on the effect of various fertilisers, applied in different ways, on some important farm crops. The results do not warrant definite conclusions, neither do they allow the recommendation of a satisfactory fertiliser practice. The experiments indicate, according to the author, some very sound suggestions. Moderate applications of non caustic fertilisers gave the best returns by the direct contact in the seed rows method. Drilling of fertilisers as a separate operation to the seeding was not equal to the direct contact method. A second set of delivery tubes distributing the fertiliser above the seed served to safeguard germination, but failed to give the benefits desired. When broadcasting discing is important. J. S. JOFFE.

The Solid Acidity of the Soil.

DE DOMINICIS, A. and DOJMI, S. (R. Istituto Superiore agrario di Portici). *Annali di Chimica applicata*, v. 15, No. 5, p. 183-206. Rome, 1925.

In the soil, bases may be found in a free or fixed state. The latter enter, in definite and constant proportions, into the composition of the molecule, forming part of the constitution of the crystalline and colloidal elements and cannot be separated without considerable chemical and structural alterations. The free bases, on the other hand, come at any rate for the most part, from the colloidal elements which cause them to he condensed by the action of a bond which differs from common chemical affinity; from such compounds all characters of saline combinations are excluded.

Loss and impoverishment of bases in these compounds do not give them either the composition or function of acids or of acid salts. The peculiarity of abstracting the cation from electrolytes leaving the solution acid, is due in these conditions, to power of absorption. The energy of the absorbing power decreases in conse uence of increase of the proportion of the fixed bases, which at a certain moment acquire the capacity of repassing into solution with very great ease. At this point, powers of absorption are still possible, inasmuch as the cations of the electrolytes go and take the place of the bases repassed into solution. The process, however, does not correspond to chemical reactions by double exchange.

Dissociation of the fixed bases cannot take place if the combinations from which they are derived, have not abandoned their coagulated condition. The increased degree of disjunction which results is the cause of

such an intensification of absorbing power on the part of the soil that the condition arises of the soluble nutritives elements remaining too actively abstracted from the action of the roots. In protecting the free bases from being washed away, carbonate of lime acts precisely through its nature of coagulant electrolyte. The conditions which calcium compounds are required to correct in soils already impoverished in free bases, are not therefore caused by the properties of non-existent or inactive compounds of acid function. In these cases, the calcium compounds do not act as neutralizers, but, on the contrary, by the known mechanism of coagulation of the electrolytes, that is by bringing back the colloidal elements from the dispensed condition to the condition of coagulated " absorbed elements " and fixing them in that condition. A. F.

Potassium Ferrocyanide and Ferric Ferrocyanide as Sources of Iron for Plants.

DEUBER C. G. (University of Missouri), *Soil Science*, Vol. XXI, pp. 23-26. Baltimore, Md., 1926.

The use of the compounds mentioned in the title as a source of Fe for *Spirodela polyrhiza* and soybeans in solution cultures with buffer mixtures gave the following results: with 0.033 and 0.056 parts per million in the form of potassium ferrocyanide the soybeans and *Spirodela* made fair growth. Higher concentrations of iron in this salt produced a slight stoppage of growth. MERCK's ferric ferrocyanide was a satisfactory source of iron for soybeans plants when the solution had a reaction of pH 5.0 but at less acid reactions growth of the plants and chlorophyll development was restricted. J. S. JOFFE.

The Dynamics of Potash Assimilation by Potash containing Silicate minerals.

DOBRESCU-CLUY, J. M. *Chemie der Erde*. Vol. 2, Part 1. pages 83-102. Jena, 1925.

The absorption of food by a plant depends on the solubility of the given compounds in the available solvents. Purely chemical means cannot entirely solve the question of food absorption by plants, since in each case we are only able to determine the salts dissolved in a certain given solvent. The author investigated the question of food absorption using varying quantities of different potash minerals, and also different solvents. The results are summarised in tables and represented graphically. He points out that in the study of solubility the logarithmic function $\log (S-y) = K - C$ can be applied, which gives the velocity of monomolecular functions. For the determination of the velocity of solution the factor C serves, and not the factor S introduced by MITSCHERLICH. From the experiments of MITSCHERLICH it follows that the determination of P_2O_5 absorption is best carried out in water saturated with CO_2, whereas for the determination of potash assimilation hydrochloric acid is the best solvent. Mica supplies the soil with potash in a much more easily assimilable form than do potash-soda-felspars. HELLMERS.

On the Erratic Weathering Solvents in New Red Sandstone in their Dependence upon External Influences.

KLANDER, E. *Chemie der Erde.* Vol. 2, Part 1, pages 49-82. Jena, 1925.

The author has been investigating the new sed sandstone region of Reinhausen near Göttingen in which weathering causes the appearance of formations similar to those found in the new red sandstone of the Pfalz and in the freestone of the Saxon " Switzerland ". He has investigated very carefully the weathering solutions and has found in them mainly sulphate together with a small amount of chlorides. Usually the concentration of these solutions depended on the thickness of the percolated rock layer, their sulphuric acid percentage depending on the layers of humus overlying these rocks. This explanation is made the more probable by the presence of ammonium. HELLMERS.

Agricultural Chemical Exercises. Part I. Methods of Analysis.

MAIWALD, K. and UNGERER, E. Published by Theodor Steinkopff. Dresden and Leipzig.

As an introduction the scope of the book is clearly set out and defined and the most necessary apparatus and the rules to be observed in quantitative analyses are described. In the next part are described the fundamental methods of analysis and their application to fertiliser investigations (potash and phosphoric acid determination, methods of titration, determinations of nitrogen and lime). Two further chapters are devoted to the analysis of fodders. The last three chapters deal exhaustively with the different methods of soil analysis: physical methods, physico-chemical and chemical and biological methods. In the case of the more important methods e. g. waterholding capacity, ATTERBERG's slime analysis, COMBER's HASENBAEUMER's and DAIKUHARA's methods of acidity determination and foodstuff analysis the authors give a full description of the correct method of carrying out an experiment together with order of analysis; whereas other methods *e. g.* electrometric determination of the pH factor, determination of fertiliser requirements by the method of MITSCHERLICH, SCHONE and KOPECKY's slime processes and the seedling methods of NEUBAUER and SCHNEIDER are just mentioned and the theory of them explained.

It is primarily intended to be a book of practical exercises for the use of students and college trained farmers. L. G.

Laboratory Book for Agricultural Chemists.

METGE, GUSTAV. Laboratory books for the chemical and related industries. Vol. 18; 232 pages. Published by Wilhelm Knapp. Halle, 1926.

The author divides his book into three main parts: natural soil elements, agricultural products, requirements of agricultural lands. In the first part he deals with the properties and with the methods of investigation of water and of soil. In the second he distinguishes between the methods of investigation of plant products and those of animal products, while the

last part deals with fertilisers and commercial foodstuffs both with regard to their investigation and the judging of them. Of particular interest from the standpoint of this journal is the second section of the first part: the soil. He deals with the physical, chemical and mechanical investigation of a soil, with the biological seedling experiments, with the investigation of moor-soils and also with the determination of substances detrimental to plant life. Even the most recent methods are described. The section closes with a chapter on the essential points to be observed in judging a soil.

The whole work reviews clearly with a guide to the literature on the subject the most important and most generally used methods of investigation and can be most strongly recommended as a concise handbook of research in scientific agricultural chemistry especially soil research.

L. G.

Soil Investigation by means of the Seedling Method.

NEUBAUER, H., *Illustrierte Landwirtschaftliche Zeitung*, Vol. 46, page 77, 1926.

The author, deals with and rejects various criticisms of the seedling method as worked out by him. He insists that his method should only be carried out by properly trained and scientifically educated workers. After pointing out the advantages of his method of determining plant-absorbable foods he remarks on the great sources of error inherent in pot and field experiments and claims that the lack of agreement of results between these and his seedling method does not in itself mean the rejection of the latter method. K. SCHARRER.

The Availability of Nitrogen in Garbage Tankage and in Urea in Comparison with Standard Materials.

PRINCE A. L. and WINDSOR H. W. (New Jersey Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 59-69. Baltimore, Md., 1926.

The object of the paper has been to study the relative availability of garbage tankage and urea in comparison with other organic and inorganic nitrogenous fertilisers and to study the rate of decomposition of urea under various conditions. Vegetation experiments were carried on in pots with sand cultures. Three crops were grown: barley, rape and sorghum It was found that the fertilising value of garbage tankage is very low. Most of the nitrogen which it contains is very slowly available and its total percentage of nitrogen is low in comparison with other forms of organic nitrogen. As a fertilising material its chief value will probably be in its use as a filler. Urea was found to be a very desirable source of nitrogen and was very nearly equal to $NaNO_3$ in availability. In some cases the crop was even better than with $NaNO_3$. In all cases it was better than $(NH_4)_2SO_4$. On the basis of 100 for $NaNO_3$, urea rates 98 % available; $(NH_4)_2 SO_4$, 88.2 %; standard tankage, 53.4 %; fish 49.2 % and garbage tankage, 14.2 %. Chemical availability tests were made

by three methods: 1. neutral permanganate, 2. alkaline permanganate and 3. oxalic acid method of KELLOG (*J. Ind. Eng. Chem.* U. S. A., Vol. 16, pp. 371-372, 1924) and compared with the vegetation tests. Not much dependence can be placed on the present chemical tests for the determination of available organic nitrogen. The rate of decomposition of urea was studied in cultures of sand, of a mixture of half sand and half soil, and soil alone. The index for determining the decomposition was the amount of ammonia found over various time periods. After 5 days only 3 % urea was converted into ammonia in sand culture, 67 % in the half sand and 90 % in the soil alone. In the soil alone 50 % was converted in 3 days. On an acid soil the rate of decomposition was retarded: after 11 days only 50 % of urea was converted to ammonia.

J. S. JOFFE.

Numerous Reactions of Moravian Soils.

SMOLIK, J. Reakeni cisla moravskych pud. *Vestnik Ceskoslovenske Akademie Zemedelske*, p. 219. Prague. 1926.

The reaction of the soil depends on climate, on the parent rock, on the vegetation and on the way it is cultivated. The writer has analysed a great number of Moravian soils and he has published some results of the analyses in *Zorávy výzkumných ústavu zemedelskych c. s.* To make his results more general, he has continued this investigation on soils belonging to various types such as degraded tschernosioms, Central-European brown soils, grey forest soils, podsolized and podsol soils. He has also taken under consideration the endodynamorphian soils (in GLINKA's sense) such as redzinas, recent deposits, etc., and has examined the reaction of all characteristic strata in the soil sections.

To determine the actual reaction (in water and in the normal KCl solution) the process with the hydrogen electrode, an electrode of gold covered with palladium is used. The titrimetric acidity is expressed in milligrammes of H. ions per 100 grammes of dry soil.

It appears from his statement that:—

1) The pH concentration of Moravian soils varies from 4.90 to 8.57 pH. The arable soils always have a higher active pH concentration in water (6.40-8.57 pH), than forest and meadows soils (4.90-7.10) of the same climatic zone and derived from the same parent rock.

2) The exchanged reaction (in the KCl N solution) oscillates between the limits; 4.40-7.30 pH in arable soils; 3.70-6.30 pH in meadow and forest soils.

3) The titrimetric acidity in water reached 0.451, and in the KCl N solution 11.456 milligrammes H.

4) The highest active pH concentration was found in the redzina (8.57 pH) and then follow in order degraded tschernosioms, Central-European brown soils, grey forest soils and podsol soils. The illuvial strata of the last three types have a greater pH concentration than elluvial strata.

5) Neutral or alkaline Moravian soils — especially the redzinas — always show lower pH concentration determined by means of colorimetric

methods than by the electrometric method (with the hydrogen electrode).

6) The pH concentration determined colorimetrically in centrifugal apparatuses approximates to the pH concentration determined in suspension by the method with the hydrogen electrode.

7) The method with the quinhydrone electrode according to E. BILLMANN gives in Moravian soils (slightly) lower results than the method with the hydrogen electrode. Since that decrease is constant and operation is very simple to carry out, BILLMANN'S; method for the practice of pedology may be recommended. THE WRITER.

Some Residual Effects of Neutral Salt Treatments on the Soil Reaction.

SPURWAY, C. H. and AUSTIN, R. H. (Michigan Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 71-74. Baltimore, Md., 1926.

This article deals with the effects, on the soil reaction of the various horizons of four soil types, profiles, of some different cations fixed by these soils from neutral salts (chlorides), after the soluble products of the soil neutral salt reaction have been practically completely washed from the soils. $CaCL_2$, $MgCl_2$, KCl and NaCl solutions were used in this investigation. The $CaCl_2$ caused only slight changes in the soil reaction whereas the $MgCl_2$, KCl and NaCl treatments increased the values of the soil. The effective order of the several cations is : Ca, Mg, K, Na. Increased solubility and hydrolysis of the soil material containing the fixed cations are believed to be the cause of the increased pH value where increases are noted.

J. S. JOFFE.

On the Influence of Soil Reaction in Practice.

TRÉNEL, M. Has the soil reaction in practical agriculture really the influence attributed to it as a result of scientific experiments? *Zeitschrift für Pflanzenernährung und Düngung*, Vol. 4, No. 8, 1925.

A contrast is made between the conditions of growth in practical agriculture, where optimum growth can be influenced by many different factors, and those obtaining in scientific investigations where all the disturbbing factors are eliminated. It was shewn in previous experiments that throughout the year the reaction remains fairly constant particularly in the case of soils rich in colloids, but is less constant in the case of sandy soils poor in colloids. The influence of fertilisers and of soil cultivation was also investigated.

The answer to the question put by the author was based on the results of the numerous acidity determinations carried out by means of the "acidometer" on soil samples from 23 large estates. The results and computations were collected and tabulated very clearly.

These results agree to a certain extent with those gained from scientific experiments and it seems that we shall be justified in concluding that the yield can be be increased by adjusting the reaction of the soil to the kind of plant which it is intended to cultivate. Most of our cultivated plants seem to show an optimum growth at a slightly acid to neutral

TABLE I. — *Optimum soil reaction for the development of different cultivated plants.*

Cultivated plant	After O. ARRHENIUS	After TRÉNEL	
	Optimum at a pH of	Obsd. breadth of growth at pH of	probable optimum at pH of
Potatoes	5.2 – 6.3	4–8	5–6
Oats	5.6 – 8.9	4–8	5–6
Rye	4.5 – 7.8	4–7	—
Wheat	5 – 7	4–8	6–7
Barley	7.2 – 7.4	5–8	7–8
Sugar beet	7.5	6–8	6–7
Lupins	4 – 6	4–6	4–5
Peas	6.7 – 8.8	5–8	6–7
Red clover	6.0 – 8.4	5–8	6–7

reaction. As an alkali reaction is just as detrimental to the growth of cultivated plants as a strongly acid reaction, the problem of the depend-dence of plant cultivation upon soil reaction, seems to be not merely a question of "soil acidity" but a question of soil reaction in general.

G. L.

Dost known thy Soil, Farmer, its Ills and Maladies ?

TRÉNEL, M. *Illustrierte Landwirtschafts-Zeitung*, Vol. 45, page 623, 1925.

Dealing with the problem of soil acidity, the author points out with great emphasis that it is wrong to speak exclusively of "soil acidity diseases", since soil alkalinity is no less injurious to plant cultivation than a strongly acid soil. K. SCHARRER.

The Utilization of Water by Plants Under Field and Greenhouse Conditions.

TULAIKOV, N. M. (Agr. Exp. Sta., Saratov, Russia), *Soil Science*, Vol. XXI pp. 71-91. Baltimore, Md., 1926.

The author studied the utilization of water by plants under field and greenhouse conditions. Under conditions of the investigation larger amounts of water are utilized during the first part of the vegetation period in the field than in the greenhouse. The loss of moisture must be ascribed to the indirect evaporation of water by the soil under the plants, something that does not take place in the greenhouse. For this reason the transpiration coefficients of all the plants in the field are higher than in the greenhouse during the first part of the vegetation period. For the majority of the early spring crops the utilization of water is not regular; there are specific periods when the plants require more moisture from the soil. With grain crops this period coincides with the period of heading out and

blooming. Plants with a long vegetation period — roots and tubers — are utilizing the soil moisture with great regularity during the whole period of their growth. Early maturing grain crops have to depend on the soil water resources, the late maturing plants may utilize the rainfall during the whole vegetation period and thus not be dependant so much on the soil moisture stored from the spring. In the field the following plants were used: winter rye and wheat, soft and hard spring wheat, oats and barley; lentil peas and noot; sorghum, Sudan grass and alfalfa; buckwheat, corn, sunflower, potatoes, carrots, pumpkins and flax. In the greenhouse the following crops were used: soft and hard spring wheat, oats, buckwheat, peas, clover, flax and sunflower. J. S. JOFFE.

Proceedings of the 2nd Commission of the International Society of Soil Science.

Groningen, February 1926; Part A.

This is only intended as a short notice of the proceedings of the 2nd Commission which were made available to all the members of the International Society of Soil Science.

It contains 23 short papers by research workers of different countries dealing with the questions of chemical soil analysis, which were discussed at the Groningen session of the 2nd Commission on chemical soil investigation. The separate papers are reviewed in detail in the literature review of this journal. L. G.

Soil Biology.

The Viability of the Nodule Bacteria of Legumes Outside of the Plant I. II.

ALICANTE MARCOS, M. (Univ. of Illinois), *Soil Science*, Vol. XXI, pp. 27-52. Baltimore, Md., 1926.

This paper covers a series of investigations on the problem of viability of nodule bacteria of legumes outside the plant. A series of experimental data is furnished on nodule production as influenced by time of storage, temperature during storage, kind of container, maintenance of organisms in pure and mixed culture in association with other nitrogen-fixing bacteria, with yeasts, moulds, and with non-nitrogen fixing bacteria on and in different media; the effect of different treatments, such as the reinforcing of the inoculation with sugar, glue, and soil in various combinations and in different concentrations; the effect of $CaCO_3$, $Ca_3(PO_2)_2$, sunlight, dessication and aeration was investigated. Extensive studies were conducted on the effect of time and dilution upon the number of the legume organisms surviving when grown in liquid media; the effect of limited and ample quantities of oxygen upon the life of the organisms grown both in liquid and in solid media; and the comparative effect of cane sugar and mannite upon the life of the legume organisms. The effect of soil acidity on the infective power of nodule bacteria was studied. It was found that when inoculated

seeds were variously treated with soil, glue and sugar, alone or in combination, some organisms remained viable and nodule production occurred after 60 days storage. In treatments with sugar, either alone or with glue or soil, the nodules developed were uniformly large and evenly distributed over the root system. Soil and glue showed no particular advantage over the untreated infusions. No significant difference in nodule production was noticed between sugar, $Ca_3(PO_4)_2$ and $CaCO_3$ in different amounts with infected soil when used for inoculation. Soils with 10 % sugar developed acidity unfavorable for *B. radicicola*. Cloth seed bags were superior for storage purposes to glass containers, *B. radicicola* and *Azot. chroococcum* showed no harmful effects upon the life and infecting power of the nodule bacteria. Soybean, sweet clover, cowpea, and garden pea bacteria, when grown together, showed no harmful effect upon each other. The activity of pea bacteria when grown on milk was not impaired by the presence of *B. prodigiosus*, *B. capsulatus*, *B. mesentericus*, pink yeast and moulds. J. S. JOFFE.

The Viability of the Nodule Bacteria of Legumes Outside of the Plant III, IV, V.

ALICANTE MARCOS, MONDEJAR (Univ. of Illinois), *Soil Science*, Vol. XXI, pp. 93-114. Baltimore, Md., 1926.

This paper is a continuation of I and II already reported and it deals with the effects of certain factors upon the life and growth of the nodule bacteria. The following factors were studied : dilution and storage, cane and mannite liquid media, oxygen supply in solid and liquid media for *B. radicicola*, shaking. The author also studied the thermal death point of nodule bacteria, *B. radicicola* and *Azotobacter chroococcum*, the effect of different kinds of soil, of $CaCO_3$ upon the thermal death point of legume organisms, the effect of soil acidity upon the infecting power of *B. radicicola* of garden pea ; studies were also made on the life cycle of various nodule bacteria as influenced by $CaCO_3$, $Ca_3(PO_4)_2$, acid phosphate, $AlCl_3$, HCl, CH_3 COOH, HNO_3 and H_2SO_4. It was found that the rate of multiplication was greater in high dilution. *B. radicicola* lived 142 days in solution. $CaCO_3$ stimulated the growth of *B. radicicola* better than $Ca_3(PO_4)_2$. The heat resistance of *B. radicicola* of garden pea and sweet clover and *B. radicicola* of cowpea and soybean was lower than the heat resistance of *B. radicicola* and *Azobacter chroococcum*. The legume organisms were killed at 50°C for 10 minutes exposure, whereas *B. radicicola* and *Az. chroococcum* were alive at 50°C for 10 minutes. Peat maintained the life of nodule bacteria at a much higher temperature than brown silt loam. Acid soils decreased the thermal death point of legume organisms. $CaCO_3$ increased the thermal death point and the keeping qualities of legume organisms. Absence of phosphate or carbonate in media resulted in the formation of bacteroids. Acetic, nitric and sulphuric acids changed the legume bacteria into bacteroids and each of these acids affected the form of the organisms specifically. J. S. JOFFE.

Some Protozoa found in Certain South African Soils.

I. FANTHAM H. B. and TAYLOR E. *South African Journal of Science*, Vol. XVIII, pp. 375-393. Johannesburg, 1921.

II. The same: *Ibidem*, Vol. XIX, pp. 340-371, 1922.

III. FANTHAM H. B. and PETERSON N. *Ibidem*, Vol. XX, pp. 438-49 1923.

IV. The same: *Ibidem*, Vol. XXI, pp. 445-479. 1924.

V. The same: *Ibidem*, Vol. XXII, pp. 355-399. 1925.

The above articles embody the first published data on the protozoan fauna of South African soils. Some hundreds of soil samples from the various regions in South Africa (humid, semi-arid, arid, temperate, subtropical) were investigated as to the number and species of protozoa occurring in them. Environmental factors, such as depth of soil sample, humidity, seasons of the year, soil reaction, frost, application of fertilisers, veldt burning, etc., were studied to some extent, but more from the zoological point of view. Practically nothing has been done to study the influence of protozoa on the fertility of the soil.

Over seventy different species of protozoa have thus far been recorded. In ordinary non waterlogged soils protozoa have normally not been met with in the trophic state. MALHERBE.

A Comparative Study of the Bacterial Flora of Windblown Soil: I. Arryo Bank Soil, Tucson, Arizona.

SNOW LAETITIA, M. (Wellesley College), *Soil Science*, Vol. XXI, pp. 143-165. Baltimore, Md., 1926.

Only those bacteria which grow aërobically were considered in this study. The soil under consideration was collected at depths of 6, 12 and 24 inches. The region may be called a " true arid " one. The number of bacteria per gram of fresh soil for the depths were as follows: 6 inches, 401 000; 12 inches 1 898 000; 24 inches, 916 000. Of the total number of colonies for all depths 52.4 % were actinomycetes, 0.77 % filamentous fungi, and 46.81 % yeasts and bacteria. The actinomycetes were actually and proportionally more numerous at 24 inches than at 6 or 12 inches. Pure cultures were isolated from the plates and studied morphologically and culturally. Morphologically, 24.1 % were cocci, 20.4 % were short non-spore bearings rods, 13.0 % were long non-spore bearing rods, 42.6 % were long spore-bearing rods and 64.8 % were Gram negative. Culturally 35.3 % fermented glucose; 28.3 % fermented sucrose; and only one form fermented lactose; 70.4 % digested gelatin and 56.5 % digested casein; 32.6 % reduced nitrates to nitrites. J. S. JOFFE.

Soil and vegetation.

The Salt Requirement of *Lupinus albus*.

ARNDT, C. H. (Univ. of Pennsylvania), *Soil Science*, Vol. XXI, No. 1, pp. 1-6. Baltimore. Md., 1926.

This is a report of a study on the composition of a solution best adapted for the study of the physiology of *Lupinus albus*. Solution and sand

cultures were used and results are summed up as follows : a very favourable total salt concentration for the growth of *Lupinus albus* is 0.0084 N when calculated in respect of the cations. The salt ratio should be 5 : 3 :4 for K, Ca and Mg ; or 5 : 9 : 4 for the nitrate, phosphate and sulphate ions, respectively. A solution composed of 0.0035 N KNO_3, 0.0021 N $CaH_3(PO_4)_2$, and 0.0028 N $MgSO_4$ will produce a favourable growth when the H ion concentration is less than pH 3.6 High concentrations of phosphate tend to produce chlorosis. J. S. JOFFE.

The Lime question, Soil Reaction and Plant Growth.

ARRHENIUS, O. With 40 illustrations and 1 table, 158 pages. Published by Akademisches Verlagsanstalt m. b. H. Leipzig, 1926.

In this book, which the reviewer can heartily recommend, the author gives an exhaustive account of the views held as to soil reaction, its origin and its influence on plant growth and on the micro-flora of the soil, and also of the methods of its determination. In addition there is a chapter on the practical application of the experimental results. The very comprehensive collection of papers on the subject which is appended will be most welcome to all workers in this field.

It would require too much space to go in detail into the different views propounded, and the many suggestions thrown out, by the author. A study of the book itself is recommended and it should prove of the greatest interest to theorist and practical man alike.

R. H. GANSSEN.

Magnesia Impregnated Soils.

BLACKSHAW, G. N. *South African Journal of Science*, Vol. XVII, pp. 171-178. Johannesburg, 1921.

The so-called Great Dyke in Southern Rhodesia is about four miles wide and extends over a distance of approximately three hundred (English) miles. It is composed of basic igneous rocks, the principal varieties so far determined being serpentine, enstatite and norite. The soils derived from these rocks are red, chocolate-coloured, and black loams, the latter type occuring on the low lying ground, whereas the two former are found on the slopes. Without knowing their geological origin one would expect that they are fairly fertile, but the experience is that they are often most infertile and do not respond to fertilisers. Chemical examination revealed the fact that the infertile type contains a great excess of magnesia over lime when treated with hydrochloric acid as also with one per cent citric acid solution. With the fertile type the lime is in excess of magnesia in both solvents. The infertile type was no doubt formed from either serpentine or enstatite and the fertile one from norite. With the limited data at his disposal the author is of opinion that when the ratio of magnesia to lime, soluble in one per cent. citric acid, exceeds 3 : 1 (lime as 1) the tendency is to experience very poor yields of most of the common crops. The Rhodesian experience is that Kaffir Corn (*Sorghum vulgare*), velve

beans (*Stizolobium* spp.), pearl millet (*Pennisetum spicatum*) and groundnuts (*Arachis hypogaea*) are fairly resistant to an excess of magnesia, whereas maize, wheat, lucerne, clover and mangolds do not tolerate an excess of magnesia. The native grasses ("sweet" grass) also thrive excellently on the magnesia impregnated soils. Liming these soils being locally impracticable, the most effective treatment thus far has been a liberal dressing of farm manure. MALHERBE.

Soil Reaction and the Growth of our most Important Cultivated Plants

TRÉNEL, M. *Illustrierte Landwirtschaftliche Zeitung*, Vol. 45, page 558, 1925.

The author describes the "acidometer" made by him and details the experiments he has made with it on the correlation of soil reaction and plant growth. K. SCHARRER.

Regional Soil Science.

The Distribution of the Main Agricultural Soil Types in Finland.

KRISCHE, P. *Die Ernährung der Pflanze*, 22nd Year, No. 5. Berlin.

In connection with the publication by the author in 1922 dealing with the main soil types in Czecho-Slovakia and in the same periodical review the author has brought out in collaboration with Prof. RINDELL of the university of Abo an exhaustive soil map showing the distribution of the main agricultural soil types in Finland. The map was based on the excellent map "Suomen Suot Finnlands Forfmaker" showing the distribution of moors in the middle and eastern parts of Finland, and published in 1909 by the Finnish Moor Union at Helsingfors, and also on the map sketches by BENJ. FROSTERUS "Finnlands Jordarter och Jordmaner *Geotekniska Meddelanden*, No. 34, Helsingfors, 1922. Supplements dealing with the heavy loamy and clay soils found in the southern parts of Finland were supplied by Prof. RINDELL. The map prepared from these sources shows that the Finnish soils consist mainly of moor soils with forest soils intervening, and that only the southern and western coastal regions contain some heavy soils while the districts round Jammerfors contain in addition some middle soils. Predominantly sandy soils are found in the districts north of Leningrad and south-east of Wiborg. In addition to the main map which proves the great importance of moor culture to Finnish agriculture, there is a map of the Finnish moors by Prof. RINDELL showing that the greatest part of the moor soils are in Central Finland. L. G.

The Origin of the Black Turf Soils of the Transvaal.

MARCHAND B. de C. *South African Journal of Science*, Vol. XXI, pp. 162-181. Johannesburg, 1924.

The black turf soils of the Transvaal and the adjoining provinces constitute a very interesting soil type about whose mode of formation much has been speculated in the past. The term "turf" is a specific South African

designation and does by no means mean a peaty soil. Farmers of the above provinces apply this term to heavy loams or clay soils and thus they also speak of *red* turf soils, meaning a heavy red loam or clay.

Some geologists were of opinion that the black turf soils contain a large percentage of humus and that they occur in low-lying or level localities with deficient drainage. Others however, observed that such soils may occur on hilly or sloping ground and that they are underlain by basic igneous rocks. From the study of South African soil literature and from observations made and from a few soil samples taken during a cursory visit through Africa by his colleague SCHANTZ, MARBUT (1) (America) expressed the definite opinion that the above black turf soils constitute a climatic soil type belonging to the tschernozem group and as such may be found on various rock formations. This stands in direct contradiction to the opinion of the Transvaal soil scientists who hold that the black turf soil is formed in situ from the weathering of certain basic igneous rocks only, under varying climatic and topographical conditions. In the above article the author defends this latter view and gives a very full description of the occurrence and characteristics of these black turfs.

Physically these soils are characterised by the very high amount of clay (particles below 0.002 mm.), the percentage ranging between 40 and 50. They are sticky and waxy when wet, and they crack and show a well marked crumbly structure when dry. Although black, the humus content of these soils is by no means high and the nitrogen is normally below 0.10 per cent. The loss on ignition varies from 5-10 per cent, but this includes some carbon dioxide and the water of hydration.

The soils are about 3-4 feet (90-120 cm.) deep, the black colour and the loss on ignition *remaining the same* throughout the whole soil profile. The black soil rests on yellow decomposing rock. Typical is the presence of (secondary) calcium carbonate. The first foot of soil usually contains a little and in the deeper soil it is visible as white concretions. At the transition level between the black soil and the decomposing rock there is present frequently, but not always, a real calcareous layer which in some cases, has been consolidated into hard massive limestone.

The black turf occurs in four big areas in Transvaal, of greatly divergent vertical distribution and with an annual precipitation ranging from about 20-30 inches (500-750 mm.). It is usually found on level or low-lying stretches of land but occasionally also on hilly situations. It always occurs as a sedentary soil on certain basic igneous rocks of similar chemical make-up in all the four regions. These rocks are norite, basalt and karroo dolerites. Plagioclase is the principal mineral and from this are formed by weathering kaolin, silicic acid and the carbonates of calcium and sodium. From the ferro-magnesium silicates, hydrated ferric oxide, silicic acid and magnesium carbonate result. All these weathered constituents are typical of the black soils, and from the above it is clear that the "clay" percentage would be high. This clay was analysed and it showed a very high silica-alumina ratio (about 60 % silica, 20 %

(1) SCHANTZ and MARBUT: *The Vegetation and Soils of Africa.* 263 pp., New York, 1923.

alumina and 15 % iron oxide). To this composition of the clay is ascribed the stickiness and impermeability of the wet soil, the result being that under the prevailing rainfall the carbonate of lime is not leached out. This explanation is the more probable, because *adjoining* the black turf soils there often occurs another very interesting soil type of the Transvaal, namely a chocolate-coloured or red heavy loam. This reddish loam is formed wherever the basic igneous rock is more ferruginous, such as the Pretoria diabase, the amygdaloidal basalt or other basic igneous rocks with bands of magnetite. The mechanical make-up of the black and the red types is practically identical, the red loams also containing from 40-50 per cent. " clay ". The chemical composition of this clay is, however, quite different to the first, the silica-alumina ratio being much smaller (about 42 % silica, 35 % alumina and 2 % iron oxide). The result is that the red loam is a well-flocculated soil and retains the crumbly structure also when wet. The soil thus remains porous and drains well, so that although it occurs under the same rainfall as the black turf and is also formed from minerals containing much " lime ", it seldom contains any calcium carbonate. This is the case throughout its whole profile which is some 15 feet (4 ½ meters) and more.

Why the colour of the relatively small amount of humus in the black turf soils should be so intensely dark, cannot yet be explained. Soil literature, however, mentions many cases where a black colour of the soil and a relatively high percentage of calcium carbonate go hand in hand.

All the above evidence goes to show that the black turf soils of the Transvaal are the normal decomposition product formed in situ from certain basic igneous rocks ; in other words, that the mother-rock and not so much the climate is responsible for this type of soil. MALHERBE.

Sol Formation and Classification.

MARCHAND, B. de C. *South African Journal of Science*, Vol. XXII, pp. 42-48. Johannesburg, 1925.

The author gives a brief general outline of soil formation and its characterisation according to the Russian school. He then discusses very briefly a few climatic soil types of the Transvaal and is of opinion that, owing to the comparatively low rainfall, the Transvaal soils are on the whole immature, *i. e.* consist only of the " C" horizon. There is, however, a strong tendency towards lateritisation especially in soils derived from basic igneous rocks. MALHERBE.

On the Formation of Soil from Diabase in Central Transvaal.

MERWE C. R. van der. *South African Journal of Science*, Vol. XXI, pp. 235 242. Johannesburg, 1924.

The soil resulting from the weathering of the (Pretoria) diabase in Central Transvaal is a deep reddish ferruginous soil. The author gives ultimate analyses of the fresh and the partly decomposed diabase rock as well as of the residual and subsoil formed from this rock. In addition the

results of three soil samples (done by the HCl extraction) from three different districts are given. The average annual rainfall (mostly during summer) of the above localities varies from 23 to 28 inches (584-711 mm.). The altitude varies from about 4,000 to 6,000 feet (1220-1830 metres) and the maximum temperatures also show great variation. The resulting soils from the diabase are, however, very similar in all respect. The author states that the " weathering is mainly due to chemical decomposition accompanied by solution and leaching of the more soluble ingredients ", such as carbonate of lime. MALHERBE.

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General Notices.

Report on the Meeting of the Second International Committee.

(Committee for Chemical Soil Analysis), Groningen, Holland. 2-6 1926.

The order of the day was as follows :—

Friday 2 April : The meeting was opened by the Chairman Prof. Dr. A. A. J. VON 'SIGMOND. Short explanations by the authors concerning the papers sent in. — Report of Messrs. Dr. H. R. CHRISTENSEN and Dr. D. J. HISSINK.

Discussion.

Saturday 3 April : Continuation of the Discussion.

Monday 5 April : Excursion under the direction of Egr. J. HEIDEMA of Groningen. Study of the 1) high moor culture and 2) visit to the Polder and Kwelder regions.

Tuesday 6 April : Recapitulation of the conclusions and preparation for publication of the proposals for the I Congress of Soil Science (Washington, June 1927). — Official closing session in the University Building. — Visit to the University Building and reception by the Senate. — Dinner to the delegates.

All meetings, except the closing meeting, were held in the " Harmonie " building. The meeting was attended by 43 persons of 12 different nationalities. The following proposal was accepted :

DETERMINATION AND REVIEW OF SOIL ACIDITY.

I. *Preparation of the test.*

It is recommended that the soil should be examined in air dried state as soon as possible after taking the sample.

This point must be particularly observed when the buffer action is examined.

It is much to be desired that further examinations on the influence of drying and the fineness of the soil should be made.

II. *Methods of determination.*

A) *Determination of the state of reaction of mineral soils.* — In examining mineral soils it is proposed always as far as is possible to make the following determinations :

1) Determination of the pH index (firstly in water decantation and if possible also in KCl decantations) ;

2) Determination of the hydrolitic acidity ;

3) Determination of exchange acidity ;

4) Determination of buffer capacity ;

5) Determination of exchangeable lime (in soils with a higher humus content).

B) *Determination of the lime requirement of the soil.* — It is recommended while employing the DAIKUHARA process to take chiefly into consideration the

buffer effect of the soil towards bases and acids for the determination of the lime requirement.

III. *Practice of the methods of determination.*

a) In scientific investigations the execution of the electrometrical determination of the pH index (if possible by means of the Chinydron electrode) is always recommended. The determination must be done in a decantation (not in a filtrate) of the soil with H_2O or in a n-KCl solution.

Proportion of the soil to the liquid at the start 1 : 2.5.

The distilled H_2O used must have the carbonic acid tension of the outer air.

b) The hydrolitic and the exchange acidity must be made in the filtrate from the shaking of the soil with n-KCl or Na acetate and if possible, also with Ca acetate.

Indicator : Phenolphtalein.

Proportion of the soil to the liquid : 100 : 250.

Duration of shaking 1 hour. The number of c. cms. N/10 NaOH used in titrating 125 c.cms. of the filtrate must be indicated.

Note : Indication of the particular method of determination is recommended in all publications on soil acidity. If nothing else is said, the index pH stands for the water decantation.

IV. *Examination of the different methods for the determination of the state of soil saturation.*

For these determinations the following methods are recommended :—

A) For the determination of the exchangeable bases " S ":

1) The method of HISSINK.

2) The simplified methods of GEDROIZ, and more especially that with n NH_4Cl and that with 0.05 n HCl.

3) The method of KELLEY.

B) For the determination of the degree of saturation " V ":

1) The method of HISSINK ;

2) Direct conductometrical titration ;

3) The method of BOBKO-ASKENASY with $BaCl_2$;

4) The method of GEHRING-PEGGAU-WEHRMANN.

V. *Examination of the laboratory methods for the determination of the lime requirement of mineral soils in comparison with field experiments extending over several years.*

It is recommended that in the different countries as many field experiments as possible should be made according to the following plan :

a) without lime

b) quantity of lime $1/3$ of the quantity of lime necessary for bringing the reaction index of the soil in question up to pH 7.0.

c) » » » $2/3$

d) » » » $3/3$

e) » » » $4/3$

As a basis for the calculation of this quantity of lime by means of laboratory experiments the direct determination of the buffer capacity according ro the JENSEN-CHRISTENSEN method is to be employed. (Proc. Int. Soc. Soil Sci. XIV p. 112, 1924). It is desirable to use the other methods as well for the determination of the lime condition.

For the technical carrying out of the field experiments attention is called to the paper of CHRISTENSEN-JENSEN: " On the quantitative determination of the lime requirement of the Soil" (*Report on the Proceedings of the II Committee of the International Soil Science Association at Groningen*, pp. 113-114).

As ground-manure there ought to be employed:

N in the form of $(NH_4)_2SO_4$,

P_2O_5 in the form of superphosphate,

K_2O in the form of 40 % potassic salt in doses appropriate for the field but not too great.

It is intended to publish in a part *B* the proceedings of the meeting at Groningen with the resolutions and an exact description of the methods proposed.

Appointment on the Committee of the II Commission. — Following on the proceedings of the II Commission at Groningen Prof. Dr. O. LEMMERMANN was appointed Vice-President in accordance with par. 10 of the Statutes, thus completing the Committee.

Prof. Dr. A. A. J. v. 'SIGMOND.
President of the Committee.

Communications.

Prof. Dr. Lemmermann was elected President of the German Soil Science Society (A section of the International Society of Soil Science).

Director Dr. D. J. Hissink Groningen, formerly Departmental Director of the State Experiment Station has been appointed Director of an independent Soil Science Institute.

Supplement to the list of Members.

Germany.

139. Bibliothek der Landwirtschaftlichen Hochschule. Bonn-Poppelsdorf. Meckenheimer Allee 102, Bonn a. Rhein.
726. Forstliche Hochschule. Eberswalde.
715. Dr. Georg DEINES. Kirchweg, 15. Kassel.
735. M. DUTTENHOFER. Hindersinstrasse 8, Berlin, (NW. 40).
684. Prof. Dr. H. KAPPEN. Institut für Chemie der Landwirtschaftlichen Hochschule Bonn-Poppelsdorf. Meckenheimer Allee, 106. Bonn a/Rhein.
681. Dr. Paul KOETTGEN, Dozent für Bodenkunde am Forstinstitut der Universität. Phil. Gailstrasse, 8. Giessen..
737. Prof. Dr. F. LOEHNIS, Direktor des Instituts für Bodekunde der Universität. Johannisallee 21. Leipzig.

724. Prof. Dr. Emil WIMMER, Prof. der Forstwissenschaft. Sternwaldstrasse 31. Freiburg i. Bad.

Austria.

686. Landwirtschaftliche chemische Versuchs- und Untersuchungsstelle. Leiter : Ing. R. SCHRAFFL. Imst (Tirol).

United States.

685. Massachusetts Institute of Technology Library. Cambridge A., Mass.
687. The General Library. The University of Chicago. Chicago, Illinois.
442. Prof. Dr. Robert BALLENEGGER, State Agricultural College. Soils Department. East Lansing, Michigan.
717. J. F. BREAZEALE. University of Arizona. Tucson, Arizona.
721. John S. BURD. Division of Plant Nutrition. University of California. Berkeley, California.
719. STANLEY W. COSBY. University of California. 320 Hilgard Hall, Berkeley, California.
710. A. B. CUMMINS. The Celite Company. Lompoc, California.
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718. Don W. PITTMAN. Agricultural College. Logan, Utah.
727. Prof. M. C. SEWELL. Kansas Agricultural College. Manhattan, Kansas.
722. Alfred SMITH. University Farm. Davis, California.
725. GORDON SURR. 321 Eight Street. San Bernardino, California.
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Finland.

680. Nordiska Jordbruksforskare föreningens subsektion för Kulturteknik (Prof. HALLAKORPI). Ahlqvistgatan, 5. Helsingfors.
678. Suomen Salaojitusyhdistys (Finlands Dräneringsförening). Hallituskatu 1. Helsinki.
679. Tekniska Högskolans lantmäteriavdeling. Boulevardsgatan, 27. Helsingfors.

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732. Prof. V. AGASONOFF. 4, rue due Chemin de fer. Bourg-la-Reine, Seine.
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739. Ing. Techn. Karl KRUMIN. Assistent an dem Laboratorium für Bodenkunde und Agrikulturchemie der landwirtschaftlichen Fakultät der lettländischen Universität Kronvalda bulv. n. 1. Riga.
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698. Prof. Dr. W. WERENSKIOLD. Universitetets geografiske institutt. Oslo.

Holland.

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713. Prof. J. H. ABERSON. Wageningen.
712. Dr. C. W. G. HETTERSCHIJ. Scheikundige aan de tweede afdeeling van het Rijkslandbouwproefstation. Prof. H. C. van Hallstraat. Groningen.

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701. Dr. C. H. OOOSTINGH, Agrogeolog aan det Deli-Proefstation. Medan (Deli). S. O. K.

Roumania.

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730. Prof. Dr. M. CHIRITESCU-ARVA. Professeur d'Agrologie et Directeur de l'Académie d'Agriculture. Cluj.

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695. Prof. G. MACHOW. Lermontowsky str. 26. Wg. 5. Charkoff.
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688. L' Académie Tschécoslovaque d' Agriculture. Jungmannova tr. 18. Praha II.
677. Stâtni vyzkumna stanice zemědělska (Staatliche Landw. Versuchsstation) Opavé.

Correction in list of Members.

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Bibliothek des Deutschen Kalisyndikates, G. m. b. H. Dessauerstrasse 28-29. Berlin S. W., *omit.*
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P. L. ANDERSON, Cuban Sugar Club, Apartado, 1973. Habana.
J. R. ZELL. Finca "El Conde", The Hershey Corporation. St. Antonio de Rio Blanco. Prov. Habana.

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Afdelingen for Landbrugets Plantedyrkning. Den Kgl. Vet.-og Landbohjoskole. Director : Prof. K. A. BONDORFF og Prof. E. LINDHARD. Rolighedsven 23. København (V).
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Siro HUDISE. The Kagoshima Imperial College of agriculture and Forestry. Kagoshima.

Dr. Agr. ADACHI MASASHI, *omit ;read* : Dr. MASASHI ADACHI.

Latvia.

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Lithuania.

Geologijos Kabinetas. Lietuvos Universitetas. Kaunas.

Norway.

Bibliothek der Landwirtschaftlichen Hochschule, sl. pr. Oslo Ås, *omit.*
Det Kongelige Fredriks Universitet Museum. Adresse: Universitetets Kasserer, Oslo, *omit.*
Dr. TORBJERN GAARDER. Laboratorium Vorsteher, Biokemisk Laboratorium. Bergens Museum. Bergen.
Prof. Dr. OLAF HOLTENDAHL. Universitetets geologiske-paleontologiske institut. Tøien. Oslo.
Docent A. E. TRAAEN. Det Mikrobiologiske Laboratorium, Norges Landbrukshøjskole. Ås.
Prof. Dr. J. H. L. VOGT. Norges tekniske højskoles geologiske institut. Trondjem.

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Dr. F. MENTCHIKOVSKY. Agricultural Experiment Station. Tel Aviv.

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Dutch Indies.

Gouvernements Kinaproefstation, Tjinjiroean, Pengalengan bij Bandoeng, Java.
Proefstation Besoeki, Directeur: Mag. Sc. J. J. S. GANDRUP, Besoeki, Java.
Proefstation voor de Javasuikerindustrie. Pasoeroean, Java.
Redactie van de Indische Culturen. Soerabaja, Java.
Rubberproefstation West-Java. Directeur Dr. O. DE VRIES. Buitenzorg, Java.
Mevr. N. BEUMÉE. Nieuwland. Buitenzorg, Java.
P. W. HOUTMAN. Chef proeftuinen der Handelsvereeniging Amsterdam Paree (Karang Dinojo), Paree, Java.
Dr. M. G. J. M. KERBOSCH. Gouv. Kinaproefstation Tjinjiroean. Pengalengan bij Bandoeng, Java.
Dr. V. J. KONINGSBERGER. Cheribon, Java.

Poland.

Landwirtschaftliche Versuchsanstalt Post Lomza skr. 32. Kisielnica.
Dr. Benjamin CYBULSKI, Directeur du Foyer de la Culture Agricole et du Champ d'expériences. Kielce. Poste Skalbmierz. Sielec.

Dr. Slaw MIKLASZEWSKI. Rue Szopena 6. Varsovie.
Prof. Dr. Zygmunt STARZYNSKI. Kraków, *dead.*
Prof. Jean DE WLODEK, U. J. Aleja Mickiewicza 17. Kraków.
Prof. Dr. Jan ZOLZINSKI. Institut der Agrikulturchemie und Bodenkunde. Dublany bei Lwow.

Portugal

3ª Secção da Estação Agraria Nacional. Lisboa. Belem.

Roumania.

Institutul Geologic al României. Soseaua Kiseleff 2. Bucuresti.
Dr. P. ENCOULESCOU. Géologue chef à l'Institut Géologique de Roumanie. Soseaua Ardealului (Kiseleff) 2. Bucuresti.
Dr. Stefan KEREKES, Chemiker in der Zuckerfabrik, Romania Mare, Fabrica de Zahar, Marosvasarheli, 2. Targu-Mures.
Dr. Teodor SAIDEL. Chimiste-chef à l'Institut Géologique de Roumanie, Section Agrogéologique. Soseaua Ardealului (Kiseleff) 2. Bucuresti.

Serbia.

Prof. Dr. Ing. Adolf SEIWERTH. Vorstand des Bodekundlichen Institutes der Universität Mazuranic. Pl. 24, Zagreb.

Russia.

Institut Selskohosiajstwennych Melioratzyi, Selsko-Hosiajstwennaja Academia Direktor: Prof. KOSTIAKOW'Y. Petrowsko-Rasumowskoje. Moskau.
Prof. J. N. AFANASIEFF. Landwirtschaftliches Institut. Gorky, Weissrussland.
Prof. W. KASSATKIN. Iwanowo-Wosnessensk Polit. Institut. Minsk.
H. K. NEGODNOFF. Landwirtschaftliche Versuchstation. La Caisse postale No. 16. Taschkent, Ustekistan-Turckestan.
W. W. NICKITIN. Ural landwirtschaftliche Versuchstation. Perm.
N. A. PORFIRIEFF. Novo Komissariatskaja, 4. 5. Kazan.
M. N. SAYTZEFF. Universität, Institut der Landwirtschaft. Mochowaya 1. Moskau.
A. A. SKORZOW. Institut der Bodenkunde und Geobotanik. Obuchowsky 14. Tashkent.
Prof. A. N. SOKOLOWSKY. Vorstand des Forschungskatheders am Landwirtschaftlichen Institut. Charkoff.
Prof. A. F. TUELIN. Staatsuniversität, Agrofakultät. Perm.
P. D. WARLIGIN. Grosser Tolmatschewsky pereulok, 18, w. 9. Moskau.
M. A. WINOKUROFF. Sibirien-Landwirtschaftliche Akademie. Omsk.
N. M. ZAITZEFF. Moskau. *omit; read:* M. N. SAYTZEFF.

Sweden.

Skogsbiblioteket. Experimentalfältet.
Kgl. Lantbruksakademien. Stockholm.

Lic. fil. GUNNAR ASSARSSON. Sveriges geologiska undersökning. Stockholm 50.
Prof. HELGE G. BACKLUND. Mineralogisches und Geologisches Institut der Universität. Upsala.
Lic. fil. GUNNAR EKSTROEM. Sveriges geologiska undersökning. Stockholm. 50.
GUNNAR GIOEBEL, c-o Dr. C. BARTHEL. Experimentalfältet.
Prof. Dr. fil. Henrik HESSELMAN. Djursholm.
Prof. SVEN ODÉN. Experimentalfältet.
Dr. fil. Hugo OSVALD. Docent. Svenska Mosskulturföreningen. Jönköping
Dr. G. TORSTENSSON. Haga Gard. Knifsta.

Czechoslovakia

Bureau pédologique du Conseil d'Agriculture. Directeur: Dr. R. JANOTA Jungmannova 32. Praha.
Zemedels'sko-technický referåt expozitůry ministerstva zemedel'stva. Stefanovicova ul. 1. Bratislava.
Institut de l'Etat pour les recherches agronomiques. Matůškova 934. Bratislava.
Pedologische Abteilung des technischen Bureaus des Landeskulturrates für Böhmen. Praha, *omit, see* Bureau Pédologique du Conseil d'Agriculture.
R. N. Dr. F. ULRICH, Assistent Karlovy University, Albertov 6. Praha VI.
Ing. J. VALICEK, Inspecteur de l'Institut biochimique. Kvetna 19. Brno.

PROCEEDINGS OF THE INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILIZERS

INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS.

HISTORY.

One of the chief concerns of the International Institute of Agriculture is of necessity research relating to the use of chemical fertilisers in the world's agricultural production, to experiments, to the statistics of production and consumption of fertilisers.

This point of view did not escape the attention of the Permanent Committee of the Institute, and from 1912 it has instituted world-wide statistics for fertilisers : its decision to publish these researches on fertilisers regularly was sanctioned by the General Assembly in that year.

The first collection of statistics on fertilisers was received so well by the international agricultural world that it has since been necessary to publish two editions of it, the last in 1924.

His Excellency Don E. VILLEGAS, Ambassador of Chili and Delegate on the Permanent Committee of the Institute, made a proposal in 1920 aiming at the organization of an international scientific investigation of the fertiliser question. This proposal found in Rome very favourable ground for its development, and the principle was immediately recognized.

In 1922, M. VILLEGAS, made a very judicious report on the production and consumption of fertilisers, and he then developed the idea of instituting tests for fertilisers, which should be arranged between different countries, and made according to rigorously comparable, standardised, scientific rules.

M. VILLEGAS' proposition could not fail to have definite results since he had at his disposal a body of experts working over the entire world, and composed of the whole of the Delegates of the Nitrate Producers of Chili. These delegates chosen by the Chilian Association from among the most competent persons on agronomic questions have been charged for many years with propaganda by experiment.

They have moreover, worked everywhere with a success of almost international renown.

To give real effect to these views, a meeting of the Chili nitrate delegates took place in Rome on the 11th September 1925 and on that occasion His Exc. DE MICHELIS, President of the International Institute of Agriculture, invited the delegates to a conference at the Institute (see Appendix I.) the foundation of an international investigation of all fertilisers being now laid.

The delegates recognizing the work of the International Institute of Agriculture and the interest of its programme, it was decided that the Association of Nitrate Producers of Chili should grant funds for prosecuting the researches. The Permanent Committee further decided to ask other groups to contribute also to the cost of this work.

The Permanent Committee of the International Institute of Agriculture decided to nominate an international Commission to carry out the programme of work planned. This scientific fertilisers commission is the first commission forming part of the Committee of international scientific researches created by the International Institute of Agriculture. The first meeting of the International Commission of fertilisers took place from the 9th to the 13th February, in Rome. It settled the details of the experiments and the observations to be made and planned a control of fertilisers (See Appendices to the report of that meeting).

M. DE SCAVENIUS, Delegate of Denmark, was appointed reporter on the fertilisers question to the General Assembly.

This delegate drew up a report very favourable to the proposed international agreement for fertilisers research. At the end of it he made a proposal whose aim was to keep the Permanent Committee in touch with the best qualified representatives of the large fertiliser producers, and of the agricultural consuming centres for mutual information, in fact with the entire agricultural world, regarding the most effective and approximate measures for facilitating and regulating the supply of chemical fertilisers.

M. DE SCAVENIUS justly remarked that various groups held similar views and that it would be easy to get them to collaborate.

"Obviously", he added, "the best basis for this organization is the International Institute of Agriculture, since one of its principal objects is the encouragement of every kind of progress in agricultural industry and at the same time the Institute remains perfectly impartial to conflicting private interests".

The General Assembly, on M. H. DE SCAVENIUS' report, was called upon to take the following decision :—

" The General Assembly, having considered the report of M. DE SCAVENIUS, delegate for Denmark, expresses its satisfaction with the measures taken to give effect to the decision of the General Assembly regarding questions on the supply of chemical fertilisers, recognizes the importance of the researches indicated in the above-mentioned report and especially of the action taken to unify the researches and experiments on fertilisers.

Charges the Permanent Committee to see that the personel of the Institute concerned shall take steps for the quickest possible realization of the programme arranged ".

These resolutions were passed by the General Assembly in 1926.

The international organisation for fertiliser research and for control of the fertiliser trade is therefore an accomplished fact since the first meeting in 1926 of the International Commission for chemical fertilisers, when the General Assembly of 1926 sanctioned the appointment of the International Institute of Agriculture as controller of the matter. Its aim will be to keep the best qualified experts of various countries in touch with one another and to continue fertiliser research according to methods fixed by common agreement, which alone can enable the science of chemical fertilisers to make rapid progress.

MEMBERS OF THE COMMISSION.

Germany : Prof. Dr. LEMMERMANN, af the College of Agriculture, *Berlin*.

England : Sir John RUSSELL D. Sc., F. R. S. Director Rothamsted Agricultural Experimental Station, *Harpenden*.

Austria : Dr. F. W. von DAFERT-SENSEL-TIMMER, sekt. Chef, Direktor der Landwirtschaftl. Chemischen Bundesversuchsanstalt, *Vienna*.

Belgium : Prof. M. A. GRÉGOIRE, Directeur de la Station agronomique de l'Etat, *Gembloux*.

Chili : M. Alejandro BERTRAND, Ingeniero Civili de Minas, *Paris*.

Denmark : Prof. Dr. Harald R. CHRISTENSEN, Statens Planteavls Laboratorium, *Lyngby*.

Spain : Prof. D. G. QUINTANILLA, Director of the Central Agronomic Station, *Madrid*.

Egypt : M. A. MOSSERI, Ex-President of the Institute of Egypt and Director of Agronomic Research of the Royal Society of Agriculture, *Cairo*.

United States : Prof. LIPMAN, Rector of New Jersey Agricultural College, President of the International Association of Soil Science, *New Brunswick*.

The International Commission for the Study of Chemical Fertilisers. 1st Congress. 9-13 February 1926.

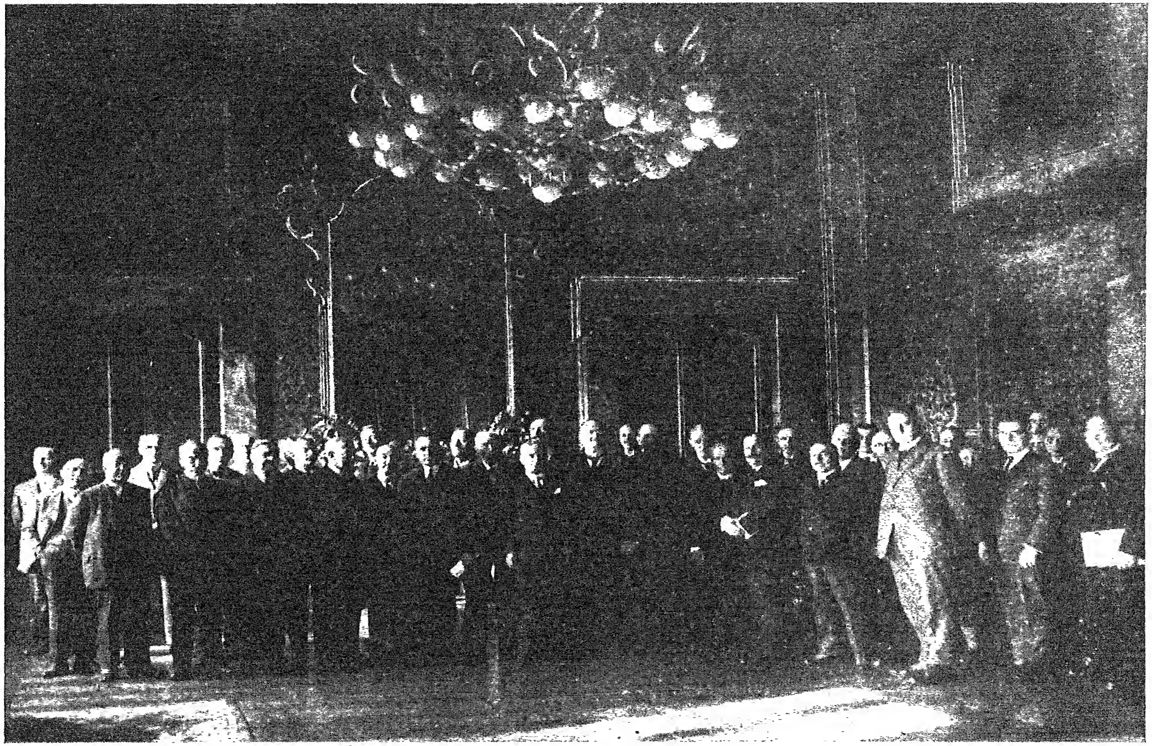

FIG. 101.—Members of the Permanent Committee of the International Institute of Agriculture. Members of the Commission. Representatives of Industrial Combines.

The International Commission for the Study of Chemical Fertilisers 1st Congress 9-13 February 1926.

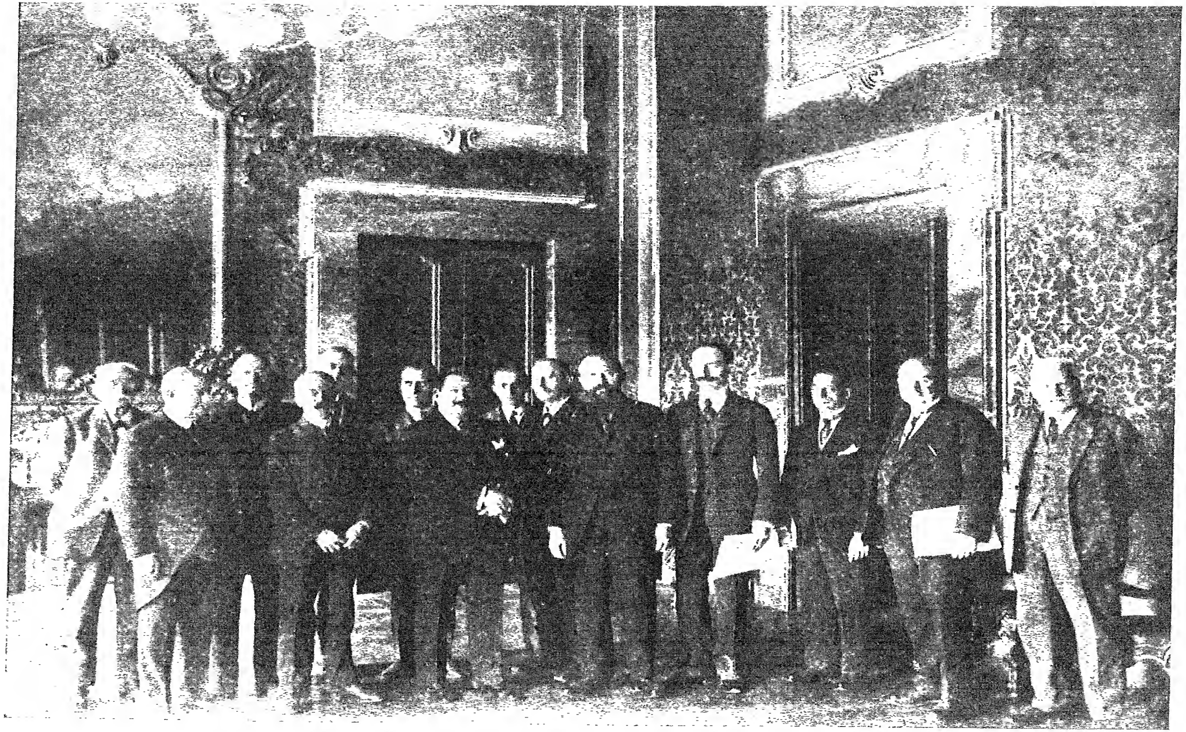

FIG. 102. — Members of the Commission.

1. Prof. ABERSON. — 2. Prof. D. G. QUINTANILLA. — 3. Prof. C. A. H. v. FEILITZEN. — 4. Prof. O. LEMMERMANN. — 5. Prof. R. H. CHRISTENSEN. — 6. Prof. J. LENDE-NJAA. — 7. S. E. G. DE MICHELIS. — 8. Dott. G. A. R. BORGHESANI. — 9. Prof. M. A. GRÉGOIRE. — 10. Prof. J. JELINEK. — 11. M. A. BRUNO. — 12. Prof. R. CARDOSO. — 13. Prof. G. WIEGENER. — 14. Prof. C. DRAGONI.

Finland : Dr. JANNES, President of the Central Commission of Agricultural Experiments and President of the Federation of Agricultural Producers in Finland, *Helsinski*.

France : M. ROUX, Direuctur des Services Sanitaires et Scientifiques du Ministère de l'Agriculture, Represented by M. BRUNO, Inspecteur Général des Stations agronomiques, *Paris*.

Italy : Prof. Angelo MENOZZI, Director of the College of Agriculture, Represented by Prof. PRATOLONGO, *Milan*.

Prof. Ettore CARDOSO, Privat docent de chimie-physique à l'Université de Genève, libero docente all'Università di Roma, *Rome*.

Japan : Prof. SUZUKI, Faculty of Agriculture, Imperial University, *Tokio*.

Norway : Prof. J. LANDE-NJAA, Professor of the College of Agriculture and Director of the Experimental Station of Research on fertilisers, *Aas*.

Holland : Dr. D. KNUTTEL, Director of the Agronomic Station, *Maastright*.

Prof. J. H. ABERSON, Landbouwhoog school, *Wageningen*.

Poland : Prof. Emil GODLEWSKI, Agronomic Institute, *Pulawy*.

Russia : Prof. PRJANISCNICOF, Faculty of Agriculture, University, *Moscow*.

Sweden : Prof. Dr. C. A. H. von FEILITZEN, Director of the Central Station of Agricultural experiment, *Stockholm*.

Switzerland : Prof. Dr. WIEGNER, Professeur au Polytechnicum, *Zurich*.

Czechoslovakia : Prof. Dr. J. STOKLASA, Director of the Station of Chemistry and Vegetable Physiology, *Prague*.

Dr. Eng. Jan JELINEK, President of the provisional Committee appointed by the Congress of Warsaw for the coordination of Agricultural experiments, Agricultural and Forestry University, *Prague*.

Secretaries.

Dr. G. A. R. BORGHESANI, in charge of the Management of the Scientific Agricultural Bureau of the International Institute of Agriculture.

Dr. Luigi RAINERI, Delegate of the Association of producers of Chilian nitrate of soda.

PROGRAMME OF THE FIRST INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS.

Opening meeting in the Salle des Réunions of the International Institute of Agriculture.

10 A. M. on the 9th February 1926.

Address by H. E. DE MICHELIS, President of the Institute.

On the necessity of scientific coordination of researches on chemical fertilisers.

Opening of the Conference.

Election of the President and nomination of Reporters and Secretaries of the Conference.

Order of busines.

Questions.

(1) Communications.
(2) Plan of international organisation for comparative tests of chemical fertilisers.
(3) Standardisation of experiments on chemical fertilisers.
(4) Control of the chemical fertiliser trade.
(5) Miscellaneous questions.

Meetings.

9th *February* 1926.

2 p. m. Commencement of business.

10th *February* 1926.

10 a. m. Continuation of business.
2 p. m. Continuation of business.

11th *February* 1926.

10 a. m. Continuation of business.
2 p. m. Continuation of business.
8.15 p. m. Banquet.

12th *February* 1926.

Business of Sub-Commission.

13th *February* 1926. 10. m.

Approval of proposals made by the Conference.
Close of business.

14th *February* 1926.

Excursion to Terni, inspection of electro-chemical works.

1st MEETING OF THE INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS (9th-13th February 1926).

Opening meeting.

9th February 1926.

Provisional Presidency of H. E. Prof. DE MICHELIS, President of the International Institute of Agriculture.

The meeting commenced at 10 a. m.

The following members who were invited to attend the meeting were present :—

Germany: Prof. Dr. LEMMERMANN, Landwirtschaftliche Hochschule, *Berlin*.

Austria: Dr. F. W. v. DAFERT-SENSEL-TIMMER, Sekt. Chef, Direktor der Landwirtschaftl. Chemischen Bundesversuchsanstalt, *Vienna*.

Belgium: Prof. M. A. GRÉGOIRE, Directeur de la Station Agronomique de l'Etat, *Gembloux*.

Denmark: Prof. Dr. Harald R. CHRISTENSEN, Statens Planteavls Laboratorium, *Lyngby*.

Spain: Prof. D. G. QUINTANILLA, Director of the Central Agronomic Station, *Madrid*.

France: M. BRUNO, Inspecteur général des stations agronomiques, *Paris*.

Italy: Prof. Ettore CARDOSO, privat docent de chimie-physique à l'Université de Genève, libero docente all'Università di Roma, *Rome*.
Prof. U. PRATOLONGO, representing Prof. MENOZZI, *Milan*.

Norway: Prof. J. LANDE-NJAA, Professor at the College of Agriculture and Director of the Experimental Station of Research on Fertilizers, *Aas*.

Netherlands: Dr. KNUTTEL, Director of the Agronomic Station, *Maastright*.
Prof. J. H. ABERSON, Landbouwhoogeschool, *Wageningen*.

Russia: Prof. PRJANISCNICOF, Faculty of Agriculture, University, *Moscow*.

Sweden: Prof. Dr. C. A. H. VON FEILITZEN, Director of the Central Station of Agricultural Experiments, *Stockholm*.

Switzerland: Dr. G. WIEGENER, Professor au Polytechnicum, *Zurich*.

Czechoslovakia: Dr. Eng. Jan JELINEK, President of the provisional Committee appointed by the Congress of Warsaw for the coordination of Agricultural Experiments, Agricultural and Forestry University, *Prague*.

Secretaries: — Dr. G. A. R. BORGHESANI.
Dr. Luigi RAINERI.

Present as guests:

Dr. Paul BERTRAM, representing the Chilian Nitrate Committee of London.
Prof. Dr. MARIANI, Deutsches Kalisyndikat, *Berlin*.
Regierungsrat JUST, Stickstoffsyndikat, *Berlin*.
M. GALLAND, Comptoir français de l'Azote, *Paris*.
Prof. MANVILLI, Société Commerciale des Potasses d'Alsace, *Mulhouse*.
M. T. H. CARROLL, B. Sc. British Sulphate of Ammonia Federation, *London*.
Ing. VOLPI, Ufficio Tecnico di Roma, dell'Ammonia Casale, *Rome*.
Gr. Uff. LAZZARINI, Società Egiziana Fosfati, *Alexandria, Egypt*.
Ing. TOMMASI, Direttore della R. Starione Chimico-Agraria Sperimentale di Roma.
Dr. Luigi RAINERI, Italian Delegate of the Association of Nitrate Producers of Chili.
Prof. Comm. BENASSI, Società Montecatini, Società per l'industria mineraria e agricola.

THE PRESIDENT OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE.

I must first of all thank the members of the Commission who have been good enough to accept the invitation of the International Institute of

Agriculture and have come to Rome to take part in the 1st international meeting for chemical fertilizer research.

I also thank all those, who so kindly honour the meeting with their presence, the guests and especially my friend Prof. Brizi, who will share in our labours in his capacity of head of the office of the Minister of National Economy and Director General of Agriculture in Italy. I regret that His Exc. Prof. Peglion, Under-Secretary of State for Agriculture, being absent from Rome is unable to attend the meeting to express the pleasure of the Italian Government at having now in Rome so important a Conference as that which we are now holding. He has sent me the following telegram :—

" His Exc. Peglion, detained Bologna previous engagement, regrets being unable attend opening meeting international research chemical fertilisers. Charges me express Your Excellency hearty thanks for kind invitation and his cordial adherence to Congress. Wishes success to this timely initiative of the Institute. Sends through your kind agency his best regards to eminent persons assembled. Hopes to be present subsequent meetings. Signed: Micheli, Private Secretary to the Under-Secretary of State for Agriculture ".

Having said this, allow me to emphasize that this first Conference of experts in the science of fertilisers is a fresh affirmation of the great work of coordination which our Institute has been charged with carrying out in the field of Agricultural sciences. The first step in that direction was made by the International Conference of Soil Science, which also was held here in 1924 ; another advance will be made by the Conference for seed control which is to be held at the Institute next year.

Thus, the action of our Organisation in the work of international coordination, follows the logical sequence of the factors of agricultural production :— soil, fertilisers, seeds, etc. It is in thus that the Institute, with the collaboration of all agriculturists in the world, desires to exercise the functions of international coordination of research in the field of agricultural science.

The importance and fundamental need of this function were already appreciated by the Institute in 1923, when our Scientific Bureau dealt with the question of standardisation of methods of agricultural experiments : so much so that our Permanent Committee, two years later, placed on the agenda of the next General Assembly the subject which constitutes the principal object of our meeting today. It is perhaps from this that the last Warsaw Conference has derived the idea of creating a Commission for the standardisation of agricultural experiments, the utility of which seem to me to have been anticipated by our work. The Institute considers that in this question, as in all others which will in future concern its action, the method of work should first be considered and subsequently the purely technical and scientific side of the problems brought before the Commission.

The method, for chemical fertilisers, as for the other fields of activity of the Institute, has already been clearly decided. The Institute constitutes an international scientific Council, of which your Commission is an organ. This organ, which we have formed by inviting to it eminent specialists of the international world, may be asked to collaborate either by

means of correspondence or by sessions convened as required, and of which our present meeting is the first.

The resolutions which will be passed by you, will come before the Permanent Committee of the Institute which, after having deliberated on them, will bring them, when necessary, before the General Assembly. The latter in turn will make them the subjects of resolutions which will be brought officially to the notice of the various Governments, which always attach the greatest importance to the decisions and wishes of the supreme organ of the Institute, seeing that it is the highest expression of the complete representation of agricultural interests in international affairs. Thus you see that the creation of the international scientific Council has made the Institute the shortest route by which scientific results may become the subject of official measures on the part of Governments.

Regarding the second point, namely the scientific side of the question, I do not venture to encroach on this delicate ground which I leave entirely to you as it is yours by right of knowledge.

For practical purposes we have prepared a programme of business as follows :—

— Plan of an international organisation for comparative tests of chemical fertilisers.

— Standardisation of experiments on chemical fertilisers.

— Control of the chemical fertiliser trade.

The first and second questions are closely connected because it is impossible to arrange an international plan of experiments on fertilisers except on the basis of standardised rules.

Of course this order of business is not imperative and you may modify it as you think fit.

Allow me to tell you simply that the question of the control of chemical fertilisers which stands third in this order of business is of exceptional importance.

Before the war, the special Commission of the International Congresses of applied chemistry, presided over by the eminent late lamented Prof. LUNGE of Zurich, dealt with this question ; but it is not yet quite ripe and requires preliminary study. It would be well, in my opinion, to refer it for examination by our Commission at a future session.

If however, I may go into some details, I should consider it expedient judging from preliminary study by the Institute, to fix first of all rules under which the experiments should be carried out as regards the proposed international plan of comparative tests.

In this matter, I think that it should be possible to arrive at definite conclusions on the following points :—

(1) Size of the experimental plots.

(2) Number of plots for each test.

(3) Distribution of plots in each test.

(4) Number of tests for each series of experiments.

(5) Fixation of types of soil for each series, so as to eliminate the variable soil factor.

(6) Fixation of climatic zones for each series, so as to eliminate the variable climate factor.

(7) Number of years or rotations of crops during which the tests should be repeated.

(8) Plant types to be chosen for the tests.

(9) Practical rules for the preparation of plots, and the management and collection of the results.

Ideas on these fundamental points once settled, the first step will already have been taken towards the standardisation of experiments which will serve also for other branches of agricultural sciences. At present, as regards the international plan of comparative tests of fertilisers a programme should be arranged, methods defined and organisation sketched.

We have first to deal with the use of nitrogenous fertilisers to which have recently been added the classic products, nitrate of soda, sulphate of ammonia, cyanamide of calcium and the whole series of synthetic nitrogenous products.

It is evident that at our period of agricultural progress, the use of nitrogenous fertilisers varies with various conditions and stages of production. Producers and consumers would be greatly benefited by the regulation of at least the chief nitrogenous products by official directions and standards.

The question of phosphatic fertilisers might then be broached and the form in which the principal produce, phosphate of calcium, might best be used could be exactly considered.

For potassic fertilisers the problem of the use of assimilable potassic silicates arises; Italy, among other countries, possesses immense deposits which are not yet worked.

Now for all experiments it is necessary to have at one's disposal special means and organisation.

I think, as the Permanent Committee of the Institute has expressed the wish and as the London Delegation of nitrate producers has shewn, that all producers for the reasons which I have mentioned, are greatly interested in those researches. There is, indeed, everything to gain from a scientific objective research for regulating the rational use of chemical fertilisers.

We shall arrange for a statistical coordination of the data in the technical department of the Institute. This will be issued in precise form in our *International Review of the Science and Praectice of Agriculture*.

I fear I have already spoken at considerable length: and therefore I hasten to open the labours of the first international conference on chemical fertilisers. In bidding you welcome, I express my most sincere wishes for a happy outcome from your meetings. These wishes, Gentlemen, are after all superfluous, on account of your world renowned competence, which is a sure guarantee that the science of fertilisers — essential interest of the agricultural world — will derive the greatest profit from your learned discussions. I now wish to invite you, in accordance with the provisional order of business, to elect a President and appoint the reporters and secretaries

of the Conference. Possibly however you would prefer to do so at this afternoon's meeting, when you will begin the practical part of the work to which you have been invited.

Dr. Jelinek (Czechoslovakia) proposed that the election of the President and the nomination of reporters and secretaries be proceeded with at the afternoon meeting, which would be at 3 p. m.

(*It was so decided*).

The meeting closed at 10.30 a. m.

Second Meeting.

Tuesday 9th February 1926 (afternoon).

Presidency of H. E. De Michelis, *President of the Institute.*

The meeting commenced at 3.15 p.m.

On the order of business:

President. — I think it desirable to emphasize what I said this morning regarding the nature of the work of this Commission, namely that the Commission need not waste time in discussing the best means of obtaining a concrete realization of the conclusions which it is going to arrive at. That is the business of the Institute which has already determined its plan and possesses the necessary means.

What we ask the Commission to do is to give its attention to the technical and scientific side of the question, and we hope to get from it very precise and valuable conclusions. That is its appointed work and for that it is not necessary to consider the subsequent work of procedure, which can be reserved for another meeting, or for the competency of the Permanent Committee. A plenary meeting of the Commission and the audience, over which I shall have the honour of presiding will take place at the end of the conference and at that meeting your resolutions will be examined ; I shall then ask you to give me advice and put forward your suggestions regarding the best method which should be followed by the Institute to realize the programme of work which it has promised to carry out. We have before us an order of business which has been arranged in the following way :—

Questions.

(1) Communications.

(2) Plan of international organisation for the comparative tests of chemical fertilisers.

(3) Standardisation of experiments on chemical fertilisers.

(4) Control of the chemical fertiliser trade.

(5) Miscellaneous questions.

I retain the presidency for a further few minutes to ask you whether you agree to consider this as the programme of your labours, or whether you think any alterations should be made in it.

M. Grégoire considered that this order of business should be modified. The order of business goes immediately into details of execution,

while the general question of the direction and nature of experiments should be previously examined.

PRESIDENT. — General direction of what?

GRÉGOIRE. — Of the manner of making the researches. At the present time, all over the world results are being published which are obtained under the most different conditions: but it is absolutely impossible to derive rules of a general kind from these results. In my opinion, the conditions under which experiments should be made should previously be examined, to enable a synthesis of results to be made, whence to deduce general rules. And at present we have not got to that point.

QUINTANILLA asked leave to make a concrete proposal with reference to the standardisation of experiments on chemical fertilisers.

PRESIDENT requested him to postpone his proposal until the meeting at which No. 3 of the order of business would be considered.

He then asked M. GRÉGOIRE to state his proposal precisely.

GRÉGOIRE expressed himself in the following terms:—

"It is a question of principle which I put forward so that it may be possible to obtain really practical results by the institution of scientific tests on experimental farms. This concerns the general direction to be followed, with reference to what has been done up to the present time but from which we have been unable to arrive at definite conclusions".

He gave examples of experiments which have been made to prove that it is not possible to obtain conclusions of a general nature from these experiments, and he expressed the opinion that the question which he had just raised was of the greatest importance for the work of the Commission.

The PRESIDENT ruled that it was a question of a general nature the solution of which would affect the discussion of various subjects on the programme of business and he asked the Commission whether it considered that it should be previously discussed. As no one wished to speak further on the order of business, that order was passed.

LEMMERMANN. — On behalf of the Commission, heartily thanked the President of the Institute for the welcome he had here given to the experts of the Commission. He expressed the opinion that the programme of business contained extremely important points for agriculture and that the work which they were about to begin would be of great utility for international collaboration in view of the progress of science and agriculture.

Election of the President.

The President of the International Institute of Agriculture invited the Commission to elect its President.

Von FEILITZEN proposed that Dr. Jan JELINEK of the Agricultural and Forestry University of Prague should be appointed President.

(*Carried unanimously*).

Presidency of Dr. JELINEK, *President of the Commission.*

JELINEK assumed the Presidency and thanked the Commission for the confidence it had shown in him. He then invited the Commission to appoint the Vice-Presidents and Reporters.

On the proposal of M. FEILITZEN there were unanimously appointed:

Vice-Presidents : — Messrs CHRISTENSEN, BRUNO and LEMMERMANN.
Reporters :— Messrs CARDOSO, GRÉGOIRE and WIEGNER.

COMMUNICATIONS.

The PRESIDENT announced :—

that Sir John RUSSELL had sent his acceptance of membership on the Commission and placed himself at its disposal, while regretting that his engagements prevented his appearing in person and assuring it that he would be present at the next meeting ;—

that M. MENOZZI had written an enthusiastic letter, at the same time announcing that he could not be present owing to the state of his health. He hoped to be able to take part in the work of the Commission at the next meeting ;

that M. BERTRAND could not come on account of engagements but promised to collaborate in the work undertaken by the Commission ;

that Mr. LIPMAN of New York was also prevented from being presont but that he placed himself entirely at the disposal of the Commission, hoping to participate in the work of the next session ;

that M. SUZUKI had not yet written. It was hoped that subsequent communications would promise the participation of this most competent member in the work of the Commission :

that M. GODLEWSKI would take part in the work of the next session ;

that M. PRJANISCNICOF keenly desired to be present but had been prevented from doing so by the condition of his health ;

that M. STOKLASA was at present engaged at Prague, but accepted membership of the Commission, placing himself entirely at its disposal ;

that M. JÄNNES had not yet written ;

that M. ABERSON would arrive the following morning ;

that M. MOSSERI could not be present on account of his engagements. He had carried out, in Egypt, a great work of standardisation and his valuable collaboration might be hoped for in the next session.

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II. PLAN OF INTERNATIONAL ORGANISATION FOR COMPARATIVE TESTS OF FERTILISERS.

III. STANDARDISATION OF EXPERIMENTS ON FERTILISERS.

GRÉGOIRE developed his proposal and, after making his excuses for having to speak extempore and slightly at random, he expressed himself as follows :—

The object of the meeting is to settle the general rules for the experiments that we may be able to make and thence to draw conclusions enabling us to forecast the future. This is the character of what we call scientific laws. To obtain these results we may support a general synthesis ; it

is therefore necessary to know the conditions under which the results are obtained.

That rule, which is of general application, leads us in all sciences to an absolutely determined type of experiment, which here is carried out on the experimental farm, where we can determine the conditions under which the results have been obtained. In experimental farms experiments can be proceeded with for years, so enabling us to take into account not only the principal but also secondary actions of chemical fertilisers.

If we wish to determine results in order to arrive at a synthesis, we must operate everywhere in the same way: we must use a farm which will enable us to specify clearly the conditions under which we operate; which will enable us to determine the influence of one plant on the others, because there are plants which explore the top soil and there are others which explore the lower part of the soil) and it is evident that the results under such conditions may be quite different from those of experiments made here and there at random.

There is also one more important fact to be considered. Agricultural soil, as we agriculturists call it, is an artificial soil, and it becomes more artificial as the progress and intensity of culture increases. It is most artificial in gardens. Our soil should be brought, from a practical point of view to a potentiality of productivity determined by the conditions of the market. The experimental farm enables us to determine the possibilities of improving the soil; enables us to bring the soil to different degrees of potentiality and to determine the means used, while experiments, as they are made at present have only a purely local value.

The proposal which I make is for a recognition that the most essential and the most perfect means of obtaining positive results is the experimental farm, which should be established, with all necessary equipment, in every region and country.

BRUNO. — I recognize the value of M. GRÉGOIRE's statements but should like to go a little further back. The experimental farm would give us results having empiric synthetic value, which may suffice for local requirements; but if we want to look clearly and scientifically into the matter, it would first of all be necessary to make various calculations.

The investigation of fertilising material should, in my opinion, start first of all by a theoretical study of the medium. It would so be possible, under theoretical conditions, to limit the number of factors and give room for agreement among scientists. I think that this research and control of fertilisers can only be begun by pot culture experiments. Some of my colleagues, and especially M. LEMMERMANN, could give us good advice on this subject.

In experiments in plots I doubt if we ought to pretend to results which are truly and strictly scientific. The number of factors which come into play in these cultural experiments is particularly large, and if that were all, it would not matter. But the fact is we do not know what it is, nor the number of factors concerned. There was a scientist who said that it was necessary to have all factors constant, except one which should be made to vary, in order to study the influence of this factor on the crops:

but the list of all the factors is unknown to us, and it is therefore almost impossible to apply a strictly scientific method; a Cartesian method.

That being so, ought we to give up the idea of getting nearer to the truth?

Experiments can only give us what they are capable of giving. Vainly the scientist investigates the conditions of the soil, its chemical, geological and other characteristics, there is always something beyond his grasp; there is the climate factor; there is the factor which the plants themselves contain; there is the mystery of plants; and then again accidental factors and disturbances, in short factors of such a nature that experiments, even when very well organised, cannot give results from a scientific point of view, unless an attempt is made to take the greatest possible number of factors into account. And then — and here, perhaps, I shall approximate to what our friend M. GRÉGOIRE has just said — I think that the experiments once organised should be followed not only by chemists, and agriculturists, but also by botanists who can observe the plant, and see if it grows in a regular manner; and I would call in the physicist go note the variations of climate; the plant pathologist to see whether the plants in the various plots keep healthy; I would even call in the entomologist who would see whether some insect is not troubling the plant, not only the foliage but also the roots. I would also hold a medical examination to see if the plants were healthy or if they suffered from parasites. In short, a sort of sanitary inspection would be required in which not only the physical and chemical but also the biological conditions might be noted. In this way the experiments would have great value and they could be compared one with another. When potato tubers are planted, there are some plots which do well and others not well. It is no use being a good chemist; it is impossible to get at the truth! I think that tests on the ground should be carried out with the cooperation of agriculturists, chemists, biologists of various types and physicists. Ten experiments so made would be worth much more than a hundred such as are commonly seen.

QUINTANILLA thought that a clear distinction should be made between moist and dry climates, because he had had the opportunity of noting that, according to those conditions, experiments with chemical fertilizers gave very different and sometimes even contradictory results.

He had made experiments during four years on numerous plots and he had been able to determine differences which were due to the depth of soil and the rainfall of the previous year, which had convinced him of the great importance of this factor, which should be taken into consideration in these experiments.

GRÉGOIRE, further developed the conditions under which the experiments should be made. It was necessary to consider different districts of countries, the different nature of the soil, etc. and to establish an experimental farm in each district. He referred to what had been done in this respect in the United States and Germany and again maintained that the experimental farm was the only means of arriving at positive results. He concluded by proposing that the Assembly should recommend to all

countries the establishment of esperimental farms as the basis of the experiments.

LEMMERMANN remarked that the question of chemical fertilisers varied greatly in different countries. He found it very desirable to establish experimental farms, but thought that the realization of such a proposal was fraught with very considerable difficulties.

In the first place, if international agreements were desired, it would be necessary to know what tests could be made uniform from an international point of view ; next agreement must be reached on the method of making these tests, and finally the questions for consideration would have to be settled.

WIEGNER. — As far as Switzerland was concerned, he found that it was impossible to establish experimental farms such as those conceived by M. GRÉGOIRE. Regions with homogeneous characters might perhaps be found in larger countries, but they would not be found in Switzerland, where differences of soil and climate were very considerable in a single region.

GRÉGOIRE insisted on his proposal, for he was certain that otherwise satisfactory conclusions could not be reached. If the conditions of the soil in which the tests were made were not homogeneous, there was no fixed starting point whence to arrive at conclusions of a scientific and general character.

He thought, moreover, that even in Switzerland — if there were regions, such as the Engadine, where conditions were really very difficult for the establishment of an experimental farm — there were however others where it would be possible to establish them.

LEMMERMANN. — Agreed with M. WIEGNER as regards soil conditions, and he remarked that, even in Germany, there were great differences in the constitution of the soil. For this reason he thought that these tests could not always give good results. All the same he thought that the tests ought to be made and that comparisons would be possible, even in cases where variations in the soil were very considerable.

Von FEILITZEN, said that experiments on experimental farms were the business of the scientist ; but for practical use what was wanted were experiments on ordinary fields, multiplied as much as possible.

GRÉGOIRE. — Agreed as regards practical farming ; but, as they were now dealing with a scientific question, he thought that if they so limited the tests centuries would be spent without anything of sure and general scientific value being accomplished. He said that he had followed the publications which had been issued in Germany on mass experiments and that he doubted very much whether it was possible to deduce from all of them anything more than data of purely local value : data of use to agriculturists but without scientific finality.

PRESIDENT. — Expressed the opinion that the experimental farm ought to be the scientific station in which unknown principles were sought for. Afterwards, when information had there been collected, they ought to try to make large scale tests. But in order to succeed in establishing settled points, experiments would be necessary for several years to enable

the experimenter to get his bearings on the question involved. In the nature of things they could not stop at the question of the experimental farm.

GRÉGOIRE. — Remarked that it was a question of application ; but if rules were to be determined in a general way the question of experimental farms must arise : and this was especially the case in countries where they had none. In Belgium he was certain that experimental farms would give results holding good for all regions in which they were established.

WIEGNER. — Insisted that the variations of soil and climate were so great that, in his opinion, it was impossible to think of making an experimental farm based on homogeneous conditions.

CHRISTENSEN. — Said that the really important question was that of the standardisation of experiments, which was not a question of experimental farms, but a question of local tests made in great numbers.

BRUNO . — Remarked that, at the present moment, it must be recognized that the idea of organizing experimental farms was only accepted with considerable reserve. Moreover, if it was wished to form experimental farms, they must be very well done, otherwise it was better not to attempt them. A public institution, especially, should not set a bad example. If experimental farms were made they must make an effort to provide them with good working stock, to place good agriculturists in charge of them and to establish them in uniform regions. Given these condition good results might be obtained.

But he did not believe that these results would hold good for adjacent farms, because they would be due to the personal activity of the man in charge of the experimental farm, who would be absent from the adjacent farm.

Moreover, the establishment of numerous experimental farms in various countries would involve considerable expenditure without a corresponding return.

He described attempts made in France, cautions though they were and made with limited means.

They were proposing to carry out researches in the agricultural stations in order to establish scientific facts in relation to the climate and soil conditions.

When the agricultural station thought it possible to formulate a proposal, it was a question of seeing whether the culture should be started at once, and, as that might be dangerous, the creation of experimental farms was thought of, which would have the object of verifiying from a practical point of view the results of the agricultural station by tests. The experi mental farm, in short, should serve as intermediary between the work of the agricultural station and practical farming. If good results were not obtained on the experimental farm, the question would be further investigated. If the tests gave favourable results, it was a question of instigating the growers to put into practice the proposition which it was wished to make general. It was then a matter of propaganda in which they would have the help of the companies who sold chemical fertilisers.

But in accordance with the programme drawn up by the Institute for

the Commission, it seemed to him that the work of the Commission should be limited to matters of research, that is to say to agricultural stations.

QUINTANILLA. — Put forward the following proposal :—

« I propose that a small commission be appointed to fix the principal points and the conditions to which the experiments must conform to keep pace with the results of tests of those fertilisers which principally concern agriculture, setting aside the question of scientific study in the laboratory and regulating the conditions of experiments, which should be carried out on a semi-industrial scale at least, so as to resemble as closely as possible ordinary field conditions ".

Presidency of Prof. LEMMERMANN.

M. JELINEK. — Remarked that the same discussion which had just now taken place had occurred at the last Warsaw Congress at which an international coordination of experiments concerning cultural varieties, tests and analyses of fertilizers was desired. He recalled the wish expressed at the conclusion of that Congress and the appointment of the Commission of which he had the honour of being President.

All the discussion which took place at Warsaw and here related to the elaboration of a common work, of a method for unifying tests and the publication of the results obtained. He recalled what the President of the Institute said and the following points on which he said that precise conclusions could be arrived at :—

(1) Size of the experimental plots.

(2) Number of plots for each test.

(3) Distribution of plots in each test.

(4) Number of tests for each series of experiments.

(5) Fixation of types of soil for each series, so as to eliminate the variable soil factor.

(6) Fixation of climatic zones for each series, so as to eliminate the variable climate factor.

(7) Number of years or rotations of crops during which the tests should be repeated.

(8) Plant types to be chosen for the tests.

(9) Practical rules for the preparation of plots, the management and collection of data.

CARDOSO. — Found Prof. JELINEK's proposal very interesting. He thought, however, that M. QUINTANILLA's proposal came into the programme of present work though of a different nature.

QUINTANILLA, proposed to form a small internal Commission which should immediately indicate to the Commission proper the method of conducting the experiments. Prof. JELINEK's proposal concerned a later time.

GRÉGOIRE. — Thought M. CARDOSO's remarks correct and that Prof. JELINEK's and M. QUINTANILLA's propositions were two different proposals, each to be examined in turn.

BRUNO. — Thought that the question put forward by M. JELINEK

might come under Nos. 2 and 3 of the programme of business and that at present the proposal of M. QUINTANILLA might be considered.

JELINEK and CARDOSO agreed with this.

PRESIDENT. — Asked if the Commission wished to appoint the small Commission at once.

GRÉGOIRE. — Proposed that the small Commission should be composed of Messrs BRUNO, QUINTANILLA, JELINEK, LEMMERMANN and WIEGNER.

THE PRESIDENT. — Put this proposal to the vote and it was unanimously approved.

The meeting ended at 5.30 p. m.

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Third meeting.

Wednesday 10th February 1926 (morning).

Presidency of Dr. JELINEK.

The meeting commenced at 10.15 a. m.

THE PRESIDENT. — Announced that the sub-commission which was appointed on the previous day had examined, in all its details, question No. 3 on the programme of business, " Standardisation of experiments on chemical fertilisers " and put forward 11 points as a basis of discussion. He asked M. BRUNO to read them out saying be would have them discussed point by point.

BRUNO. — Read out the 1st point :

(1) *Soil* ..... Choose a soil as uniform as possible, and test it by a sufficient number of borings ; arable layer ..... cm., subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If a sloping ground has to be used mark out rectangular plots elongated at right-angles to the run of the valley.

PRESIDENT. — Opened the discussion on this point. As no one wished to speak, he declared it adopted.

BRUNO. (2) — *Shape of the plots.* Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

He remarked that the Commission had not wished to make a pronouncement on the choice of the square or rectangular shape as it considered that this might be left to the discretion of each person according to the local conditions.

PRESIDENT. — Ascertained that all were agreed on this second point and declared it adopted.

BRUNO. (3) — *Area of the plots.* Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

(*Adopted*).

(4) — *Number of plots* — Repeat the same test at least 5 times and have at least 5 control plots.

(*Adopted*).

(5) — *Distribution of the plots* — Distribute them as well as possible according to the dimensions and lie of the ground

GRÉGOIRE. — Was of opinion that it would be better to use the word "uniformly" instead of the phrase "as well as possible".

BRUNO. — Explained that the Commission had examined various possibilities for the distribution of plots; first of all the Norwegian method which consists in placing one control plot, two plots, one control plot, two plots, ... then the method of distributing the same plots in a central part of the ground; it had also considered the recommendation of certain statistics of indicating the plots by letters or numbers and distributing them at random. And finally the Commission considered that it is not always convenient to have a very large uniform ground, which may be square, elongated, etc. and that it was best to leave it to each person to make the best distribution possible.

GRÉGOIRE. — Insisted on his proposal to use the word "uniformly" which seemed to him more precise.

PRESIDENT. — Ascertained that there was no opposition to the modification proposed by M. GRÉGOIRE. He therefore declared point 5 approved with the substitution of the word "uniformly" for the words "as well as possible".

BRUNO. (6) — *Paths between the plots* — The plots should be contiguous, except for leaving a path, in a single direction, 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For harvesting plants on a width of 50 cm. inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of one metre on three sides and by 1 m. 50 on the side of the path.

(*Adopted*).

(7) — *Duration of the tests.* — Continue the testing of the same areas during 5 years on successive crops.

(*Adopted*).

(8) — *Characteristics of the soil and climate.* — Note them and publish them with the results :— *Soil*, locality — depth — analysis. *Climate*, temperature — humidity — rain — nebulosity.

LEMMERMANN. — Proposed to add to this point that these analyses should be carried out in accordance with the method which would be determined by the International Commission for soil science.

CARDOSO. — Thought it would be well to add as regards meteorological observations, "actinometric degree", before "nebulosity", which seemed to him a very important factor.

QUINTANILLA. — Was of opinion that the amount of rain and the number of wet days should be added.

PRATOLONGO. — Thought that the duration of sunshine should be determined.

GRÉGOIRE. — Explained that this was done at Gembloux by means of a very simple and easily handled instrument.

BRUNO. — Considered that it was not desirable to go into details to avoid imposing obligations which could not be complied with everywhere.

CARDOSO. — Agreed with M. BRUNO not to introduce measure factors which would complicate the results ; he thought, however, that it would be useful, as M. PRATOLONGO said, to determine the duration of sunshine, but on condition that a very simple apparatus was used which would give the factors :— intensity and duration ; and that very simple and easily handled apparatus could be purchased.

von FEILITZEN. — Thought that it would be sufficient to say that the meteorological observations should be made in each State in accordance with the official methods, and that the Commission would be going outside its business in giving details of a meteorological kind, which belonged to the province of other groups of persons. In the same way regarding the proposal of Prof. LEMMERMANN to adopt for the analysis of the soil the method which would be prescribed by the international commission of pedology, they might also refer to specialists on the subject. Consequently he was of opinion that by the word "actinometry" they could include everything without going into details.

QUINTANILLA. — Was of opinion that it was not desirable to prescribe the method of the international Commission of pedology, which might only suffice when much propaganda and several tests of the method itself had been made. Consequently he thought it best not to refer to the method of the Commission of pedology but merely to give general instructions.

PRESIDENT. — Proposed that in order to find a formula reconciling all these points of view, point No 8, should be sent back to the Sub-Commission for supplementary examination.

(This proposal was adopted).

BRUNO. — (9) — *Plants used.* Always use well tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(Adopted).

(10) : — *Remarks on growth.* Note the essential facts of growth, their dates. Attacks of diseases or of parasites. Weeds. Treatments applied. Casualties or damge caused by meteorological factors or fortuitous.

GRÉGOIRE. — Thought it necessary to specify here the conditions under which the spreading of the fertilisers and the sowing of the seeds should be done. He added that there were mechanical means for this.

BRUNO. — Said that this had been overlooked by the Sub-Commission. He remarked that it was difficult to determine conditions for the even spreading of the fertilisers and the even sowing of the seeds ; and he did not know whether mechanical means existed. Nevertheless M. GRÉGOIRE might draw up a short proposal which the Sub-Commission would examine.

PRESIDENT. — Ascertained that no one opposed this. M. GRÉGOIRE would therefore draw up his proposal which would be handed to the Sub-Commission.

Point 10 *was adopted.*

BRUNO. — (11) :— *Crop.* The whole crop of each plot should be weighed after drying under shelter when this is possible especially with the use of small plots (25 sq. m.). When large plots (100 sq.m.) are used it becomes necessary to take a sample of each plot for drying under shelter, weigh it, and make the necessary examination of it. In this case the method adopted should be indicated.

CARDOSO. — Did not know whether these details should be gone into, but it would be useful to specify the weather conditions during the drying.

GRÉGOIRE. — Thought that the most precise method was that of WAGNER, which consists in weighing the crop immediately, taking a sample of the crop, drying it and determining on the product obtained the content in dry matter : in this way absolutely certain figures were obtained.

PRATOLONGO (representing M. MENOZZI). — Remarked that there were two methods :— WAGNER's and that of the Commission. He recognized that WAGNER's method of weighing the whole crop was the better but it was also more difficult. Consequently he would suggest not going into details, or else indicating both methods.

GRÉGOIRE. — Was of opinion that WAGNER's method, which had the great advantage of simplifying the work, should be adopted. At harvest time agricultural labourers were at full strength on the farm and the work could be done quickly, whereas a considerable number of plots meant difficulty in handling.

LEMMERMANN. — Considered that it was indispensable not only to weigh the green crop but also always to determine the dry matter.

BRUNO. — Proposed that in order to take into consideration the observations which had been put forward point 11 be sent back to the Sub-Commission for another indication aiming at the result in dry matter according to the most appropriate method.

(M. BRUNO's *proposal was adopted*).

GRÉGOIRE. — Remarked that the 11 points which had been submitted to the Commission did not affect the question raised of experimental farms, which in his opinion was very important, even fundamental as experiments in detail could never give complete results, for which the experimental farm with a wide area was indispensable. He consequently asked that the Commission should come to a decision on the following proposal which he had the honour of submitting to it :—

" The Commission considers that the most certain means to put in action for the integration of scientific data concerning chemical fertilisers is the creation for each agricultural region of experimental farms with a plan of action extending not only over fertilisers, but also over work ".

PRESIDENT. — Announced that this proposal would also be submitted to the Sub-Commission He then remarked that they had at present to discuss the question " Plan of international organisation for comparative tests of chemical fertilisers " and he asked whether the Commission wished to have a general discussion or to refer the question at once to the Sub-Commission which would prepare the basis of the discussion.

(*It was decided to refer the question to the Sub-Commission*).

PRATOLONGO. — Desired to call the attention of the Commission to 2 points which he had not seen dealt with in the Sub-Commission's report, namely that of the analysis of the fertilisers.....

PRESIDENT. — Said that this would come later.

PRATOLONGO. — The other point concerned a rule in order to understand whether the experiment were conclusive or not. He thought it would be useful to determine this by statistical means. This was a recommendation which he wished to make to the Commission.

CARDOSO. — Remarked that M. BRUNO in his very precise and clear statement of the previous day had spoken of the collaboration in these experiments of scientists of various branches of science, chemists, botanists, phytopathologists, etc. and he asked whether it would not be well for the Commission to express the wish that these experiments should be followed by scientists such as M. BRUNO indicated. That would permit of an infinitely better control and the obtaining of results which could be discussed with greater exactness. As regards the standing of these scientists it was a matter for discussion; he asked that in the first instance the principle should be admitted.

BRUNO. — Said that the Commission in its note had implicity accepted the principle of control by specialists, and he wondered if it was necessary to say so more precisely. He thought that collaboration was extremely desirable and everyone was agreed on this point, but he did not know that it was necessary to make a hard and fast rule which might be an obstacle. to certain experiments. In any case, the Sub-Commission might also examine this point.

(It was decided to refer his proposal also to the Sub-Commission).

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Fourth meeting.

10th February 1926 (afternoon).

Presidency of Prof. JELINEK.

The meeting commenced at 3.30 p. m.

PRESIDENT. — Announced that the Sub-Commission had accomplished its task and that it had changed its recommendations in some points, consequent on what had been said in the morning meeting.

BRUNO. — Read the new text.

Nos. 1 to 6 remain without any alteration.

1. *Soil.* — Choose a soil as uniform as possible, and test it by a sufficient number of borings, arable layer ..... cm. subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If sloping ground has to be used mark out rectangular plots elongated at right-angles to the run of the valley.

2. *Slope of the plots.* — Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

3. *Area of the plots.* — Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

4. *Number of plots.* — Repeat the same test at least 5 times, and have at least 5 control plots.

5. *Distribution of the plots.* — Distribute them uniformly according to the dimensions and lie of the ground.

6. *Paths between the plots.* — The plots should be contiguous, except for leaving a path, in a single direction, 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For harvesting plants on a width of 50 cm. inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of one metre on three sides and by 1m. 50 on the side of the path.

After No. 6 has been added a No 6 (*a*) worded as follows :—

6. *a*). *Distribution of the fertilisers.* — The fertilisers should be applied accurately and regularly, special attention being given to the application of farmyard manure. Each fertiliser should be applied at the most suitable time for good effect, in one or several applications.

(*Adopted*).

To No. 7 which was worded as follows :—

Duration of the tests. Continue the testing of the same areas during 5 years on successive crops, it was proposed to make a small modification.

Instead of " 5 years " should be substituted " at least 5 years ".

(*Adopted with this modification*).

No. 8 has been slightly modified :—

8. *a*) *Composition of the fertilisers.* — Always give precise indication of the fertilisers used :— nature, origin, fineness, complete chemical analsis, and eventually petrographic or microbiological characters.

(*Adopted*).

Nos 9, 10, have not been altered :—

9. *Plants used.* — Always use well-tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(*Adopted*).

10. *Remarks on growth.* — Note the essential facts of growth, their dates, attacks of diseases or of parasites. Weeds. Treatment applied. Casualties or damage caused by meteorological factors or fortuitous.

(*Adopted*).

11. *Crop.* — It is recommended that the results should always be expressed in air-dried matter and in dry substance (constant weight at 100°).

GRÉGOIRE. — Remarked on No. 11 that they might be content with the determination of the density, for the system recommended here was very lengthy and could only be recommended for laboratoy experiments.

BRUNO. — Said that this proposal was rather ideal and it had been made to define clearly what they wished to expect.

GRÉGOIRE. — Insisted, saying that experiments had been made in Belgium with both methods; the results agreed very closely but the density method was infinitely quicker.

PRATOLONGO. — Thought that it sufficed to strike out the words

"constant weight at 100°" and leave the chemists to arrange as they thought best.

(*Adopted with this elimination*).

11 (*a*). *Experimental error.* — The experiment will be considered as demonstrative when the differences of the averages results obtained are less than double the probable error.

GRÉGOIRE. — Asked that it should be clearly defined how the probable error was to be calculated. It might be defined with the second power, or else with the first power and for his part he was convinced that the definition could be done in either case with equal certainty. But when the second power was taken large differences greatly influenced the value calculated.

PRATOLONGO. — Thought that they were two identical values and that moreover, such details ought not to be gone into.

QUINTANILLA. — Agreed with M. PRATOLONGO.

GRÉGOIRE. — Insisted that the differences were greater if the calculation was made with the second power. He thought that the calculation with the first power was more exact and more convenient.

PRESIDENT. — More convenient, yes; but not more exact.

GRÉGOIRE. — Did not think, moreover, that it was a case of a negligible detail. As a basis was taken, it was expedient to settle how the basis ought to be calculated.

CARDOSO. — Wondered whether the experiments were sufficient for this calculation. It was necessary to use a formula; that formula depended on theoretical ideas implying a fairly large number of observations. Did that number exist? He did not think so.

GRÉGOIRE. — Assured him that many results had already been obtained so that he thought that after 5 tests the formula could be used.

BRUNO. — Thought that it was not necessary to be too particular about being precise.

GRÉGOIRE. — For his part found that it was necessary to state the starting point precisely in order to reach a conclusion. He insisted in his proposal that it should be stated that the probable error must be calculated with the first power.

PRESIDENT. — Put the Commission's proposal to the vote and it was approved.

11 (*b*). *Experimental Farms.* — The Commission considers it advisable to establish an experimental farm in each natural region, subject to the direct control of laboratories of the various departments cooperating in the improvement of agriculture.

IV. — CONTROL OF THE CHEMICAL FERTILISER TRADE.

BRUNO read the following decision of the Sub-Commission:—

The Commission considers it impossible, in a short time, to reach an international agreement for unifying the methods of fertiliser analysis.

It thinks it possible to recommend, for international transactions, unification of the method of expressing results of analyses namely:—

for nitrogenous fertilisers, expression in nitrogen, N and not NH_3 per 100 kilogrammes, the form of the nitrogen to be indicated.

for phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents.

for potash, expression in K_2O, and solubility in water, or in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used.

GRÉGOIRE. — Considered that there is a term which should be extended to international language, namely that of cyanamide and cyanamidic nitrogen.

BRUNO. — Thought that M. GREGOIRE's proposal deserved to be thoroughly examined because, perhaps, the term "dicyanamidic" ought to be included.

PRATOLONGO. — Said that a single group ought to be formed of cyanamidic and dicyanamidic nitrogen because it was organic nitrogen in each case.

BRUNO. — Feared that the Commission might be involved in a very lengthy discussion. Cyanamide was not only sold in a natural state but also in other substances, and the Sub-Commission was unable to take into consideration terms on which it was not very well informed. Perhaps the question would make progress before the next Conference and then it might be possible to see the matter more clearly.

The term which M. Gregoire proposed to indicate. included a certain number of things which have a certain relationship but which are not identical. They could say, at present, "nitrogen derived from cyanamide".

GRÉGOIRE. — Thought that his proposal ought to be adopted in order to obtain a certain uniformity of language. He insisted that greater precision of language must be reached and said that, in Belgium, many terms were obligatory for merchants in their invoices, by authority of a royal decree.

QUINTANILLA. — Proposed to appoint a Sub-Commission for dealing with the question which was No. 4 of the programme of business, for he considered that it would not be easy to arrive at concrete and positive conclusions by discussing it in a plenary conference.

PRESIDENT. — Put this proposal to the vote.

(*Adopted*).

He proposed that the Sub-Commission be composed of Messrs. Von FEILITZEN, GRÉGOIRE, BRUNO, LEMMERMANN and QUINTANILLA.

(*Adopted*).

V. MISCELLANEOUS QUESTIONS.

PRESIDENT. — Announced that M. LEMMERMANN had put before the Commission the following proposals on the Control of the chemical fertiliser trade.

They were as follows :—

(1) In the first place, it is necessary to determine by a *definition* what substances should legally be called "fertilisers". In that definition

should be comprised all preparations which are offered to the agriculturist, often indirectly, as fertilisers, for example, bacterial preparations, means of soil improvement, irritant substances (radioactive substances), etc.

(2) The denomination of fertilisers should indicate clearly their nature, they should not therefore bear fantastic names, such as:— Universal fertilisers, concentrated fertilisers.

(3) The vendor should indicate precisely the fertiliser's content in substances affecting its value and guarantee the content indicated.

(4) Precise figures should be fixed for admissible deviations relative to the guaranteed content (errors of analysis, margin.)

(5) The method of taking samples should be regulated and also it should be determined whether, in case of dispute, the sample taken from the vendor or that taken from the buyer should be taken as evidence.

(6) It should be determined what laboratories have the right of testing fertilisers :—

Whether only (1) State institutions,

Or also (2) Private laboratories.

In any case, if there is a dispute the decisive analysis should only be made in an official laboratory.

(7) It would be desirable to forbid the sale of fertilisers other than those approved by the State.

(8) The methods of analysis according to which analyses of fertilisers may be made should be determined.

(9) It would be desirable that these same rules should apply to international trade. For example, Chili saltpetre is analysed in certain countries by the direct method, in others by the indirect method; superphosphate is analysed in some countries according to the P_2O_5 content soluble in water, in others according to the P_2O_5 content soluble in alkaline citrate of ammonia, etc.

As M. LEMMERMANN asked that his proposals might be distributed so that all members of the Commission could think them over, he asked the Vice-President of the Institute whether — since these proposals could not be considered sufficiently ripe for deliberation — the procedure could be adopted of requesting the Institute that they might be placed on the programme of business in the next session.

PRESIDENT. — The Sub-Commission which we have appointed will recommend the Commission to request the Institute to distribute these proposals among all members so that they may be able to give their opinions in the future.

BRUNO. — We have here a basis for discussion formulated in writing by M. LEMMERMANN. They are clear, distinct, precise proposals: some of them will certainly not be accepted, and even M. LEMMERMANN is under no delusion in this respect: some of them will be accepted with modification. But certainly, there is in them a basis for discussion. Therefore, in order that everyone may be able to think them over and give their opinions at the next session, these proposals should be distributed.

PRESIDENT. — I have here a communication by M. von FEILITZEN.

von FEILITZEN. — Read in English the communication printed in Appendix II. 3.

The meeting ended at 6 p. m.

The members of the Commission were convened to a meeting reserved for them next day at 10 a. m.

Fifth meeting.

Thursday 11th February 1926 (morning).

Presidency of Dr. JELINEK.

The meeting commenced at 10.30 a. m.

H. E. Prof. DE MICHELIS, President of the Institute was present at the meeting.

PRESIDENT welcomed H. E. DE MICHELIS who had come to the meeting.

H. E. DE MICHELIS, President of the International Institute of Agriculture addressing the members said that, with Messrs. JELINEK and BRUNO, he had examined the suggestions which had been made on the subject of the method of business to be adopted for the next meetings of the Commission. And it had been decided — subject to the approval of the Permanent Committee of the Institute, an approval which he thought he could at once say would be accorded — that the convocation of the Commission would take place a short time before the date of the conference ; that the programme would be sent in advance to the Members of the Commission to make modifications in it which they might suggest ; that the reporters, at any rate for the principal questions, would be appointed in advance, so that in the meeting of the Commission there would already be some members who would have thoroughly studied the subject under examination ; that these reports and the office reports would be typed and sent to the members of the Commission as quickly as possible and at least a week in advance. He concluded by saying that if any one had any proposals to make on the subject of the work of the Commission they might be examined at once.

PRESIDENT of the Commission ascertained that no one wanted to speak on that subject ; consequently the method of business explained by the President of the Institute was adopted.

PRESIDENT OF THE INSTITUTE then spoke as follows :—

" I do not know whether you have an exact idea of the organisation given to your international scientific council. The Institute wished to fortify itself with the advice, direction, the scientific and technical guidance of an international body composed of scientists and experts ; and as it might have been difficult to deal at once with the constitution of a large organisation of this kind, it determined to proceed by stages and began by creating these international scientific councils, each composed of authorities recognized by all countries as scientists whose opinion was worth listening to. It has thus created the Commission for chemical fertilisers, to which you all belong and which will be the nucleus of our Council ; again the Commission of Agricultural statistics, some of whose members

have been appointed specially for the agricultural census of the world, which has already met here to examine the plan of work for the census put before it by the Institute ; and the Institute will continue to appoint other Commissions which may deal with the examination of certain questions from different angles, either separately or together. And as it is not always easy to assemble Commissions and it is desirable that the questions should be thoroughly prepared in advance, the Institute has also arranged to have the advice of experts by means of consultations.

As regards the working of the Commission, the Permanent Committee has selected a list of names, — a list which is not closed, for you yourselves can propose other colleagues who may also be added, — and the Commissions have been immediately assembled. At present it is the Permanent Committee of the Institute, composed of representatives of 71 States, which will examine your work, your technical scientific advice, and will decide what further proceedings should be taken. Then if your proposals are adopted, the Institute will take the matter up, its bureau will collect the technical or legislative material and will present properly drawn up questions to the General Assembly which meets every second year. As you see we have here an organisation which has existed for 18 years for all branches of agriculture, has collected enormous material, has suitable services, has a permanent diplomatic international organisation, is in constant relations with the Government of each country and is in a position to bring immediately into the field of realization whatever scientists can investigate and discover.

This is the first time that the Institute has set in motion these technical scientific Commissions, and I hope that the work which you have accomplished will be fruitful in good results for the work which the Institute has in hand.

PRESIDENT. — Thanked H. E. DE MICHELIS for his speech and for the explanation which he had given regarding the functions of the Commission. He then announced that the Sub-Commission had examined Nos. 2 and 4 of the programme of business namely the questions concerning (*a*) the plan of an international organisation for comparative tests of chemical fertilisers; (*b*) control of the chemical fertilisers trade.

With regard to the first question, the Sub-Commission recommended the following resolution :—

" The Commission expresses the wish that the work relating to researches on fertilisers should be continued by the International Institute of Agriculture by means of its agents of the Commission which it has appointed with that object and which might conveniently be enlarged, and that the works to be published on that question should be included in the International Review of Agricultural Information published by the Institute ".

As no one wished to speak, this resolution was adopted.

Regarding the question of control of the chemical fertiliser trade, the Sub-Commission recommends the following resolution :—

" The Commission considers it impossible, within a short time, to reach an international agreement for unifying the methods of fertiliser analysis. It thinks it possible to recommend for international transactions, unification of the method of expressing the results of analyses, namely :—

For nitrogenous fertilisers, expression in nitrogen, N, and not NH_3 per 100 kilogrammes indicating the form of the nitrogen.

For phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents.

For potash, expression in K_2O, and solubility in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used ".

As no one wished to speak this resolution was adopted.

Regarding No. 5 of the programme :— *Miscellaneous questions.*

PRESIDENT. — Announced that the Sub-Commission had considered for the future the two following questions :—

(1) « The discussion of M. LEMMERMANN's proposal regarding control of chemical fertilisers and his proposal regarding the plan of experiment should be postponed to a later session.

With this object all official documents relating to methods of analysis and rules in force in different countries should be centralised at the International Institute of Agriculture ».

BRUNO. — Explained that the Sub-Commission had recommended the centralising of all official documents at the Institute, because it was not enough to have the methods of analysis and the laws and decrees relating to them, as there were also circulars and the modifications which resulted from legal decisions. In France, for example, there was a circular giving details of application. Now it was useful from an international point of view for men of one country to be kept in touch with the current requirements in other countries.

PRESIDENT. — Ascertained that no one opposed this proposal, and declared it approved.

(2) :—

" That the questions relating to various fertilisers or substances capable of affecting growth be also postponed ".

BRUNO. — Did not know whether this question could form part of the programme of the next meeting. In any case the Commission had not forgotten this matter, but considered it premature to deal with this question

on the spur of the moment, as time was required to collect papers and the proposals made on the subject and to sort out scientific proposals from those of pseudo-science.

PRESIDENT. — Ascertained that no one opposed this 2nd proposal, and declared it adopted.

A report would be made on all the resolutions adopted by the Commission, which would be presented for the approval of the Commission at the closing meeting, which would be held on Saturday 13th at 10 a. m.

The programme of business being then finished, he thanked once more the President of the Institute who had shown his great regard for science in creating this Commission of experts, which would do its best to assist the work of the Institute in the field of world agriculture.

PRESIDENT of the International Institute of Agriculture said that be would communicate the speech of the PRESIDENT of the Commission to the Permanent Committee of the Institute which would be glad to know that the Commission had worked so carefully and successfully.

The meeting ended at 11,15 a. m.

Closing meeting.

Saturday 13th February 1926.

Presidency of the PRESIDENT *of the International Institute of Agriculture.*

The meeting commenced at 10.15 a. m.

PRESIDENT. — Declared open the closing meeting of the 1st Conference of the International Commission for Chemical Fertilisers.

He announced that the Commission had presented a report in which was summed up its work and the conclusions to which it had come by the aid of its two Sub-Commissions. The report ended with the presentation of recommendations and wishes which would now be submitted for final approval. He called on M. JELINEK, President of the Commission to present the recommendations and wishes of the Commission.

JELINEK. — Said that M. CARDOSO would do so in his capacity of reporter.

PRESIDENT. — Asked M. CARDOSO to read out the resolutions question by question.

CARDOSO. — Then, in his capacity of reporter, presented the text of the agreement to be finally adopted by the Commision. He spoke as follows :—

" As regards the 1st question on the programme, 'Plan of international organisation for comparative tests of chemical fertilisers' the following resolution has been adopted :—

The Commission expresses the wish that the work relating to researches on fertilisers should be continued by the International Institute of Agriculture by means of the competent agents of the Com-

mission which it has appointed with that object and which might conveniently be enlarged.

That the work to be published on that question should be included in the International Review of Agricultural Information published by the Institute ".

PRESIDENT. — Declared that this resolution, which moreover agreed with the ideas which he had the honour of expressing on the opening day of the work of the Commission, conformed to the programme of business and to the ideas of the Institute and he could at once give an assurance that it would be approved by the Permanent Committee.

He ascertained that no one wished to speak ; he declared that recommendation unanimously adopted.

He asked M. CARDOSO to read out the recommendations regarding the second question " Standardisation of experiments on chemical fertilisers ".

Prof. CARDOSO. — Read out the following rules:—

INTERNATIONAL RULES FOR SCIENTIFIC EXPERIMENTS ON FERTILISERS.

(1) *Soil.* — Choose a soil as uniform as possible, and test it by a sufficient number of borings, arable layer down to ..... cm. subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If sloping ground has to be used mark out rectangular plots elongated at rightangles to the run of the valley.

(2) *Shape of the plots.* — Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

(3) *Area of the plots.* — Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

(4) *Number of plots.* — Repeat the same test at least 5 times and have at least 5 control plots.

(5) *Distribution of the plots.* — Distribute them uniformly according to the dimensions and lie of the ground.

(6) *Paths between the plots.* — The plots should be contiguous except for leaving a path in a single direction 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For the harvest, plants to a width of 50 cm inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of 1 metre on 3 sides and by 1.m. 50 on the side of the path.

(6*a*). *Distribution of the fertilisers.* — The fertilisers should be applied accurately and regularly, special attention being given to the application of farm-yard manure. Each fertiliser should be applied at the most suitable time to have good effect, in one or several applications.

(7). *Duration of the tests.* — Continue the testing of the same areas during at least 5 years on successive crops.

(8) *Characteristics of the soil and climate.* — Note them and publish them with the results: — *Soil*, locality, depth, analysis (methods of the International Association of Soil Science, and for dry climates repeated determinations of the humidity of the soil). *Climate*, temperature, nebulosity, rainfall :— quality and number of days — snow — actinometry.

(8*a*). *Composition of the fertilisers.* — Always give precise indications of the fertilisers used :— nature, origin, fineness, complete chemical analysis and finally petrographic or micro-biological characters.

(9) *Plants used.* — Always use well-tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(10) *Remarks on growth.* — Note the essential facts of growth, their dates, attacks of diseases or of parasites. Weeds. Treatment applied. Casualties or damage caused by meteorological factors or fortuitous.

(11) *Crop.* — It is recommended that the results should always be expressed in air-dried matter and in dry substance.

(11 *a*). *Experimental error.* — The experiment will be considered as demonstrative when the differences of the average results obtained are less than double the probable error.

(11 *b*). *Experimental Farms.* — The Commission considers it advisable to establish an experimental farm in each natural region subject to the direct control of Laboratories of the different departments cooperating in the improvement of agriculture.

President. — Ascertained that no one wished to speak. He therefore considered that all these rules were unanimously adopted by the Commission.

He asked the reporter to read out the resolution relating to the third question " Control of the chemical fertiliser trade ".

Cardoso. — Read out the following resolution:—

The Commission considers it impossible, in a short time, to reach an international agreement for unifying the methods of fertiliser analysis.

It thinks it possible to recommend, for international transactions unification of the method of expressing results of analyses namely :—

for nitrogenous fertilisers, expression in nitrogen, N. and not NH_3 per 100 kilogrammes, indicating the form of the nitrogen ;

for phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents ;

for potash, expression in K_2O and solubility in water or in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used.

PRESIDENT. — Declared this recommendation unanimously adopted. As regards proposals for the next meeting, he asked whether there were any other proposals besides that of M. LEMMERMANN, which had already been examined at the previous meetings.

BRUNO. — Thought that it would be useful at once to determine some subjects and he had already come to an arrangement with most of the interested parties regarding the reports which might be elaborated in view of the next meeting. He would therefore indicate the questions with the names of the proposed reporters.

REPORT FOR THE NEXT MEETING.

(1) Special implements for the execution of cultural experiments. Reporter, Prof. GRÉGOIRE.

(2) Dry climate and fertilisers. Reporter, Prof. QUINTANILLA.

(3) Choice of soil for experiment, borings, examination and reaction of the sample. Reporter, Prof. CHRISTENSEN.

(4) Presentation of the results of cultural experiments. — Standardization, notes, diagrams. Reporter, Prof. VON FEILITZEN.

(5) Practical application of experiments. Reporter, Prof. MENOZZI.

(6) Experiments on the relative efficiency and net return of manurings. Reporter, Prof. LEMMERMANN.

(7) Critical study of legislation and systems of control of the trade in chemical fertilisers in use in various countries. Reporter, Prof, JELINEK.

(8) Critical study of methods of analysis of fertilisers, in use in various countries. Reporter, M. BRUNO.

PRESIDENT.—No one wishing to speak, this programme is consequently adopted. We have in it a good piece of work which supplements the very interesting framework of the deliberations of the Commission ; the names

of the reporters are a sure guarantee of the seriousness of the reports and of their importance. At the last meeting of the Commission I had the pleasure of telling you that for the next conference of the Commission we hope to send invitations sufficiently early for the programme to be issued in good time and, as far as possible, to be correct. It will be subject to amendments and suggestions by the Commission. The reporters will be appointed in advance for the essential questions, as has already been done, and we hope by sending shortly the reports of this first conference to members who were unable to be present this session, among whom are some occupying a very eminent position in the field of chemical and agricultural science, to arouse in these gentlemen some ideas which have not yet been dealt with by the Commission and so to get further reports.

There are lastly, as you know, two proposals by M LEMMERMANN : one has already been included in the report considered ; the other relates to plans of experiments.

He proposes that

> " all official documents relating to methods of analysis and to rules in force in various countries should be centralized at the International Institute of Agriculture ".

No one wishing to speak, the proposal is therefore adopted.

M. JELINEK thanked the PRESIDENT of the Institute and assured him that the Commission would use all its knowledge and zeal in helping the Institute in its task.

M. QUINTANILLA made the following speech :—

Mr. PRESIDENT, Allow me on behalf of all my colleagues to offer our best thanks to you and to the Permanent Commitee of the Institute for the honour which has been paid us in inviting us to Rome for this important conference. We have known the International Institute of Agriculture for a long time, a magnificent work of human solidarity and progress, whose creation was due to the generous sentiments of H. M. the King of Italy, an institute which has already rendered considerable and universally appreciated services in all branches of agriculture from an international point of view. Its publications and manifest activities have bruited abroad to all the world the excellence of its organisation and the competence of its staff, a staff recruited from all countries in the world. Scientific circles of every country have heard with very great pleasure and interest of the recent creation of the International Scientific Council of the International Institute of Agriculture, of which our Commission is one of the organs.

As you have rightly said, Mr. PRESIDENT, the Institute ought, among other primary functions for the welfare of universal agriculture, to play the part of coordinator of scientific initiative and research in the agricultural world which would otherwise be disconnected and consequently deprived of a good deal of their efficiency.

The International Institute of Agriculture, which is an organisation of States and has the right of initiative with governments by the terms of

its foundation charter, is in a unique position, through the agency of its Permanent Committee and its General Assemblies to effect the incorporation in laws and measures of an official character of the recommendations and wishes which it requires from us experts on stated questions. Research is not enough unless it ends in practice. The International Scientific Council of the Institute is a typically elastic creation which can continually expand by the formation of new commissions, and thus render inestimable services even to governments and the entire human race, subject however to the condition that these Commissions are composed of the most qualified men of renown. My colleagues and I, who are specialists, know quite well that all branches of agricultural economy and science are bound up together, that the agricultural problem has administrative, political and social sides, which only a State Institution can consider as a whole. We therefore wish a long and prosperous existence to this Institute, under your vigorous and enlightened Presidency and under the management of a Permanent Committee on which all States in the world are represented. We all know, M. President, your indefatigable activity, the originality of your views and the very vigorous manner in which you defend the interests and the prerogatives of the great Institution of States, to the head of which you have been called by the unanimous confidence of your colleagues on the Permanent Committee. Thanking you and the Permanent Committee for having invited us others who are present here, we wish you M. President, the Permanent Committee and the whole Institute a prosperous and fruitful life for the welfare of agriculture all over the world. (*Applause*).

The PRESIDENT of the Institute replied as follows :—

I think that the speech which has just been made has suggested to the President the programme of work which remains for him to accom plish.

I am particularly happy to be able to be here at the end of this first experiment of the organisation which the Permanent Committee, on my suggestion, has adopted for constituting the scientific Council of the International Institute of Agriculture, because it should be noted, and everyone will note, that the work accomplished by this Commission has been — the expression is not out of place — truly important. During their meetings competent men assembled here have found themselves all agreed, after having examined the matter which was submitted to them, in presenting resolutions which mark a stage in the study of the question of chemical fertilisers by fixing the principal points for the establishment of the necessary methods for future experiment. This is a very interesting and important matter from an agricultural point of view because, perhaps in this field more than in other, it is necessary that the most economical methods of production should be pointed out to the producer, seeing that such demonstration has a happy result for the consumer.

The Commission has therefore fixed precise points for the experiments which will be begun in future, and this will throw considerable light on experiments which have been made up to the present time.

I therefore wish to thank all members of the Commission and in par-

ticular its President M. JELINEK, the three Vice-Presidents Messer. CHRISTENSEN, BRUNO and LEMMERMANN, who have given the Commission the support of their world renowned competence. I also thank the reporters who have drafted the resolutions voted.

I think therefore that the commencement of the work of our Scientific Council is auspicious and as M. QUINTANILLA has just said, this work will enable the Permanent Committee to expedite the appointment of other Commissions; and the results that will be obtained from the work of these Commissions may throw a deserved radiance on the Scientific Council. We have here a permanent observation post; the Institute is the permanent propagandist of all that is useful to agricultural production; henceforth we shall have here an organisation which will give greater authority to our efforts and to our work. I thank you again for having come to Rome and for having accepted our invitation, and I hope that on return to your countries you will remain attached to the Institute by the recollection of the agreeable work which you have done and for which we are grateful to you.

I also hope that you will take back with you from this country, if not the luminous vision which we generally have here because of the sun and the fine weather, at least the impression of its living activity and of its desire of peace and quietness, and that you will never forget that surrounded by the lawns of the Villa Borghese there is a palace where a group of workers is ready to collaborate for technique and science in the field of agriculture. (*Applause*).

I announce the termination of the 1st conference of the Commission for the Study of Chemical Fertilisers.

The meeting ended at 11.15 a. m.

VISIT TO THE HYDRO-ELECTRIC AND NITROGEN FIXING WORKS AT TERNI.

After this first conference, the "Terni", a hydro-electric company, was good enough through its Manager Delegate, Chief Engineer Bocciardo, to invite the experts and observers to visit the establishments situated at Terni and at a place near by. A number of persons taking part in the excursion went to Terni on Sunday 14th February, where the engineers and chemists belonging to the Company were placed at their disposal to accompany them through the workshops and to explain their working. In the morning the hydro-electric station situated near Papigno and then the kilns for the manufacture of carbide and the operations for the transformation of the latter into cyanamide, were visited.

After an excellent lunch given to the visitors, they were accompanied in motors to Borgo Nera Montoro where there is a very fine establishment for the manufacture of synthetic ammonia, and these magnificent works and the most up to date high tension machinery were greatly admired. The guests were shown over the works at Terni with the greatest courtesy and rare competence by Engineer Comm. ALDIGHIERI ably assisted by Engineers SINIBALDI and GEMMA.

BANQUET.

The International Institute of Agriculture invited all members of the Commission to a banquet which took place on the 11th February 1926 at 8.15 p. m. at the Excelsior Hotel.

At this banquet the PRESIDENT of the International Institute of Agriculture, M. JELINEK President of the Commission and Dr. BERTRAND on behalf of the audience who were present at the meetings of the Commission, made speeches.

They warmly thanked the Institute for the invitation it had given them, and Dr. BERTRAND especially gave an assurance that the whole support of the chemical fertiliser industry was at the disposal of the International Institute for the great work undertaken in the interests of worldwide agricultural progress. At this banquet were present :— H. E. Prof. PEGLION, Minister of National Economy ; the Delegates of the Permanent Committee and several eminent Italian agricultural authorities.

RATIFICATION BY THE VIII GENERAL ASSEMBLY OF 1926 OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE OF THE DECISIONS TAKEN BY THE FIRST CONFERENCE OF THE INTERNATIONAL COMMISSION ON CHEMICAL FERTILISERS.

" The General Assembly,

having seen the Report by M. H. DE SCAVENIUS, Delegate of Denmark, expresses its satisfaction with the measures taken with the object of carrying out the decision of the General Assembly of 1924 concerning questions relating to the supply of chemical fertilisers, recognizes the importance of the investigations indicated in the above-mentioned report and especially of the action taken for unifying research and experiment in the matter of fertilisers ;

recommends the Permanent Committee to see that the energy of the Institute in this field may be directed towards the practical realization, as soon as possible, of the programme arranged ".

APPENDIX I.

MEMORANDUM ON THE INTERNATIONAL ORGANISATION FOR THE STUDY OF CHEMICAL FERTILISERS.

Presented on the occasion of the visit of delegates of the Association of producers of Chili nitrate of soda to the International Institute of Agriculture by Dr. G. A. R. BORGHESANI, Head of the Agricultural Scientific Service of the International Institute of Agriculture.

Ambassador VILLEGAS' *proposals for international co-operation.*

His Excellency, Don E. VILLEGAS, Ambassador of Chile and Delegate to the International Institute of Agriculture, since the General Assembly of the Institute of 1920 drew attention to the importance of encouraging the use of chemical fertilisers in view of the intensification of agricultural production.

Later, on the occasion of the 6th General Assembly in May 1922, H. E. VILLEGAS in his Report on production and consumption of chemical fertilisers proposed co-operation for the benefit of the progress of agriculture and the fertiliser industry as follows :—

« It is evident that the Institute cannot propose practical measures regulating the trade in fertilisers without first studying the interests involved. The necessary basis for this is already given, namely the results obtained by the enquiry on fertilisers and the publication of a monograph on this question by the Institute.

« When presenting my resolution on the occasion of the last General Assembly I spoke about the meeting held in Rotterdam in 1919, which was attended by all the principal combines interested in the production of nitro genous fertilisers such as Nitrate of Soda, Sulphate of Ammonia and other synthetic nitrogenous fertilisers.

« During that meeting the question was brought forward of the study of certain problems of this production, and a common action was suggested similar to the one, in view of which agreements had been come to with and within the combines of other chemical fertilisers such as Phosphates and Potash Salts.

« As a matter of fact, in spite of the conditions being different on certain points, we are informed of a tendency of co-operative work between these combines.

« The first question to be considered for such action is that of taking the initiative and I think that the Institute, which is and must always be outside all party interests, should be approached for this function.

" This question could be brought up again a further stage, and it would serve the purpose if the Institute would have prepared for that occasion all the necessary papers, and having previously obtained the authorisation of the Governments concerned, could bring itself into touch with the organisations in question ".

Decision of the VI. General Assembly of the International Institute of Agriculture.

The General Assembly approved the motion of H. E. VILLEGAS and came to the following conclusion :—

" The General Assembly notes with satisfaction the work accomplished with regard to supplying information to the producers and consumers of chemical fertilisers regarding the most convenient steps to be taken with a view to developing the use of chemical fertilisers and

decides

that the Permanent Committee after having communicated with and having obtained authorisation of the Governments should study the possibility of

keeping itself in touch with the great fertiliser combines as well as the consuming circles of agriculture, in order to advise the most efficacious and appropriate means and measures for facilitating and regulating the economical provision of chemical fertilisers in the joint interest of the producers as well as of the agriculture of all the world ".

The reasons put forward by the Chilean Delegate are so obvious and convincing that there is no need to go any further into this matter.

The same point of view was also taken a few months ago at Paris on the occasion of a meeting of the " Comptoir Français de l'Azote ", which was attended by many representatives of the fertiliser industry of various countries.

The usefulness and even necessity of joint action being undisputable, there only remains the question of the organisation thereof and it seems that the International Institute of Agriculture offers the best ground for such organisation, as it has amongst its objects the promotion of the progress of agricultural industries and is at the same time extraneous to all party interests.

Need of an International Agricultural Research Organisation.

The Institute has already promoted similar movements in other branches of Agricultural Science, such as the International Society of Soil Science and the International Seed Testing Association etc., and it is the Agricultural Science Bureau of the International Institute of Agriculture which is the acting organ of this movement. This service, considering the process of agricultural production as such, can have a marked and decided influence on the increase of the production of agricultural staple products in all countries which need it, especially European ones, and can also render the production more profitable for countries, which have already an abundant production as for instance the United States.

In fact, if we consider the technical organisation of agriculture we find it much behind that of industry, trade and finance. From this arises the first cause of the inferiority of agriculture in comparision with industry, commerce and finance, which have taken advantage of the progress in modern science. This progress is essentially due to the universal character of science to which all the world gives its share, whilst for agricultural science every country, even every agronomist works on his own account, so that the experience gained by one does not serve anybody else, failing which the application of such experience on a large scale is impossible.

This deficiency of the agricultural industry, which is one of the reasons of its bad situation, is indeed felt especially in the more progressive countries, and remedies for this situation are being tried in different quarters.

The International Institute of Agriculture by means of its Agricultural Science Service has in part promoted this movement, of which it could be the coordinator.

In fact we see that around the Agricultural Science Bureau there have been formed the following associations :—

The International Society of Soil Science, which unites already all the experts of this science, so important to agriculture, from Japan to the United States, from Finland to South Africa, from Argentina to Polynesia ;

The International Seed Testng Association, which comprises more than 400 seed testing stations all over the World;

The International Combine of Wheat Breeders;

The International Association of Poultry Breeders;

The International Federation of Dairymen;

The International Commissions of Olive-growers;

The International Commission for Eliminating the Damages caused by industrial Smoke, and many others.

Indeed, on the occasion of the last International Congress of Agriculture in Warsaw there was not one branch of agriculture in which the necessity of international coordination was not felt, and with this coordination the International Institute was entrusted.

As can be seen, the work proposed is immense and requires the co-operation of all the scientists and agronomists of the world.

An International Scientific Fertilisers Service.

It is evident that the Agricultural Science Bureau cannot be substituted for work in every branch of agricultural science, but as we have previously seen, can be a very useful co-operator and can help to obtain good results.

Its chief activity will always consist in collecting, classifying and distributing all useful information on agricultural questions. The difficulty of this work is to execute it thoroughly so as to have all information complete and clear cut, and the only way to attain this is to develop the work branch by branch with the help and co-operation of all quarters concerned.

This has been achieved in the cases of the International Society of Soil Science and the International Seed Testing Association. Thus the International Institute of Agriculture publishes the first complete review on soil science, and beginning with next month also the first international periodical on seed testing.

The same might be arranged for the fertiliser industry, namely the publication of a quarterly *Review* containing original articles by experts on all important and actual questions of this industry, and also complete abstracts of all publications concerning the production and consumption of fertilisers. A third part of this Review might contain a statement of the fertiliser market as compared with that of agricultural products, there being evidently a strict relation between the prices of these two lines of wares. This part will be an international development of the corresponding very interesting information given for Germany by the German review " Zeitschrift für Pflanzenernährung und -Düngung ". Such publication, as a part of the *International Review of the Science and Practice of Agriculture*, would be of the greatest interest for the producers, as well as for traders and consumers' organisations of fertilisers, to whom a special reprint might be sent as is similarly done for the members of the International Society of Soil Science.

Connected with this there might be also a service of *Information* on the basis of the Card system of the Institute, which at present has already collected more than 200,000 cards giving notice of all information on agriculture contained in the 3000 periodicals received by the Institute.

The Institute would also organise special *Studies* and *Research* work, such as is already effected by the publication of the Monograph on production and consumption of fertilisers, which has served as a basis for international fertiliser statistics, and which in the course of time naturally ought to and will be completed and improved.

On this occasion one may also mention the proposal of an *International plan for the organisation of comparative tests of fertilisers*, which will be brought forward at the next General Assembly of the International Institute of Agriculture. It is well known that agricultural field experiments have not yet given the results expected, and the principal reason for this is the lack of a common plan and of standardisation of experimental methods.

The best progress has been attained in the more highly developed agricultural countries such as Denmark, Finland, Germany, etc., and it has been found that experiments in order to give useful results must be executed on the largest scale possible, following the three fundamental principles :—

(1) Uniform management and work all over the world with regard to agricultural experiments ;

(2) Close participation and co-operation in the experimental work on the part of practical agriculture ;

(3) Co-ordination by a special control organisation.

Strict adherence to these three rules, even for individual countries only, is the secret of the success of milk recording in Denmark, which has quintupled the production of milk per head.

As previously said, in order that such intelligence service may be useful, there must be a close co-operation of all interested and we think that the help of the Delegates of the Chilean Nitrate Producers' Association might be very useful indeed for obtaining not only printed but also direct information through their direct and wide experience.

Summary.

In conclusion we think that the Agricultural Science Bureau of the International Institute of Agriculture with the co-operation and help of all the competent fertiliser organisations can develop a useful international action on the following lines :—

(1) Publication of a *Quarterly Review* containing all the information on fertiliser industry in the world ;

(2) An *Information Service* by means of the card system ;

(3) Preparation of special studies and researches ;

(4) Organisation of meetings and conferences for the treatment of urgent questions ;

(5) Co-operation of all the fertiliser organisations of the world in the shape of an International Consulting Board or Committee connected with the Agricultural Science Bureau of the International Institute of Agriculture.

There remains the question of means.

Evidently, the Institute can offer its organisation, but to develop the work efficiently, a certain contribution on the part of the interested parties would be required.

To quote a figure without engagement, we think that a sum of about 100,000 Lire a year for the beginning would be sufficient, increasing up to a maximum of 1,000,000 Lire.

At first, for the launching of the *International Fertilisers Review* and *Information Service* the first quoted sum would suffice; another question however is the development of research work on a large basis and the preparation of the special studies, which would require additional means.

Altogether, we think that the figures quoted for developing this preliminary programme, supported by all the fertiliser organisations, would not weigh upon them very heavily, but can even be considered as small in comparison with the results obtained. This amount would only be partly used for staff and similar expenses at the Institute, the main part would be expended for the organisation of co-operative work all over the world.

APPENDIX II.

Communication presented at the conference by Prof. Dr. Lemmermann.

It would certainly be very useful if a part at least of the thousands of researches on fertilisers were made in accordance with a single plan.

A better general view of many very important questions affecting the practical rules for the use of fertilisers would be obtained in this way. The interest of these researches would be still further increased if the results collected were studied and coordinated in accordance with a single plan in a single centre.

Such researches thus organised would evidently be of great utility for various agriculturists as well as for agriculture as a whole and for the social economy of each country.

All questions relating to plant nutrition are in the highest degree questions affecting the feeding of the people. On the basis of these considerations I have tried in Germany since 1924 to make researches on fertilisers throughout Germany in accordance with a single uniform plan of experiments.

Under this plan should be rigourously determined :—

(1) What soils in the various regions of Germany react to a manuring with N, P_2O_5 K_2O, lime, what soils do not react ?

(2) In what quantities should the fertilisers be applied ?

(3) What maxima crops can be obtained ?

By continuing in this way, we hope to establish an international plan of organisation for tests of fertilisers, and an agreement on the fertiliser problem would in my opinion be very desirable and should be placed in the programme of such an international plan of experiments, since the problems of fertilisers differ very much one from another and each requires a special method of research.

I think that out of the whole of the questions affecting manuring the following might be discussed by an international organisation :—

(I). *Investigation of the efficiency of different forms of nitrogenous, phosphatic, potassic fertilisers* : for example, effect of nitric Nitrogen, ammoniacal Nitrogen, Nitrogen of cyanamide of calcium, etc.; effect of acid phosphates, basic phosphates; effect of salts of potash, salts with high percentage, etc.

These questions are really important for agriculturists and for the manufacturers of fertilisers in all countries. (See IV).

(II). *Researches on the production of various fertilising elements, especially nitrogen.*

Nitrogen is the element which in most cases has most influence on yields.

On the average 1 kilo. of nitrogen gives the following extra yields:

	cereals	grains	potatoes	sugar beet	mangolds	hay
Kg.	19	20	100	133	266	40

or 100 K. of nitrogenous fertiliser give an excess of 2.5-4, 15-20, 20-25, 35-40, and 6 quintals respectively.

Even if the soil is left out of consideration these figures differ according to the climate. More accurate estimates can be made when the results of observations have been more accurately obtained.

(III). *To what extent can increased crops be obtained in various countries by means of the use of fertilisers, taking the net return into account.*

Estimates have shown that the highest possible crops in the temperate zone are per hectare :—

About 100-200 quintals of organic matter
40-48 » » cereals, grain + straw.
300-350 » » potatoes + haulms.

It seems that the limiting factors, light, heat, do not permit of higher yields. The importance of this question is evident.

(IV). Another question of general importance is this:

In what combination do fertilisers act best?

Experiments make it appear that the nitrogen, potash, and phosphoric acid of the fertilisers have often a totally different action according as they are used in different combinations, each with its different chemical and physical characters.

I have found, for example, that the same quantities of fertilising elements gave the following crops according to their combinations :—

(pH of the field 5-6 according to manuring).

	Potatoes	Barley	Sugar beet
Neutral manuring (Urea and dicalcic phosphate).	207	33.2	355 q.
Acid manuring (Sulphate of ammonia and superphosphate)	228	33.8	314
Basic manuring (Saltpetre and Thomas slag)) .	152	30.4	392

(V). Another question which requires a plan of research is this: *How best to adapt the artificial fertilisers to the manurial state of the soils.* This question means the fixing of the soil's requirements of fertilisers.

The solution of this problem is the primary basis of all rational manuring and is particularly important, Laboratory researches in pots are a valuable help.

(VI). In these research plans the question of the *reaction of the soil*, the question of the state of soundness of the soil should not be neglected.

It must be decided whether this question should be discussed on the programme, since it is still far from being solved, and also it is to form the subject of international discussions in April 1926 in the Netherlands (Groningen) and in 1927 in America by competent specialists of the Association for soil research which is already in communication with the soil Bureau of the United States.

APPENDIX III.

REPORT BY DR. E. S. VOMULA DIRECTOR OF THE GOVERNMENT LABORATORY OF AGRICULTURAL CHEMISTRY IN FINLAND.

Presented by M. JÄNNES.

About the middle of the XIX[th] century Justus von LIEBIG having opened new channels by his experimental work and having demonstrated the great importance for agriculture of natural science especially chemistry, the first stations of experimental agriculture and control for agricultural produce were founded.

When later the first chemical fertilisers appeared on the market all civilized countries recognized the necessity of having special chemical laboratories for testing these products. Finland also shewed a keen interest in the chemical investigation of the principal agricultural questions during the years 1850-1860. Some fifteen more years however elapsed before the aspirations of agricultural chemists and agriculturists in Finland were realized so as to establish the required results on a solid basis. The foundation in 1880 of the chemical laboratory for agriculture and commerce at Helsinki (Helsingfors) may be considered as one of the practical results of these aspirations. This first laboratory of agricultural chemistry and control in Finland began to function at the beginning of the following year.

It only required a short time for the services rendered by the Helsinki laboratory to agriculture to be recognized in agricultural circles and for other similar though slightly smaller laboratories to be founded in other parts of the country. During the years 1880 to 1890 in all four other chemical laboratories for agriculture and commerce were established in the following towns :— Turku (Abo) Viipuri (Wiborg) Vaasa and Kuopio : at present only the first three still exist. As their denomination indicates, the Finnish control laboratories investigate not only fertilisers and cattle foods but also other kinds of goods. In the early years after the creation of these laboratories the number of samples of fertilisers and foods investigated only represented a fraction of the total number of analyses made. This was after all very natural, for Finland then had not yet any law regulating the fertiliser and cattle food trades, and persons practising agriculture only rarely asked for the testing of goods which they bought. Consequently it was not possible to prevent the circulation in trade of worthless and adulterated fertilisers and of injurious or damaged cattle foods.

In order to introduce better arrangement and greater security into the trade of these products a regulation of the trade in fertilisers and cattle foods was published in 1901. It is from the date of its publication that the official control of agricultural products effectively started in Finland, but this regulation was not sufficiently severe to put an end to commercial abuses ; it was defective in various ways. Thus, for example, the vendor was not obliged to give the purchaser a guarantee certificate regarding the content of the goods for such of its integral parts as constituted its value ; consequently the farmers only derived very little benefit from this regulation and agricultural circles have never been satisfied with it.

During the years of the war and especially during those which came immediately after them, agriculture expressed a desire for fresh legislative regulation of the fertiliser and cattle foods trade.

Recognizing the justice of this desire, the Finnish Government in 1921 charged a commission, under the presidency of Dr. JUHO JÄNNES, with the elaboration of a draft law on the fertiliser and cattle foods trade. The draft was finished in 1923 and submitted to the Reichstag in the course of the same year. Having been passed by the Reichstag the law come into force on the 15th June 1924.

This law marks great progress in the control of agricultural products in Finland. One of the most important provisions of this law is that the vendor is always obliged to give the purchaser a guarantee regarding the component parts of the goods which determine its value, when the quantity of goods sold in a single lot is not less than 100 kg. The regulation for the application of the law indicates the manner in which the integral parts which determine the value should be designated. We quote, for the sake of example, the following prescriptions :—

When selling Thomas slag, its content in phosphoric acid soluble in a 2 % solution of citric acid must be indicated. For bone meal the purchaser must be informed regarding the total quantity of phosphoric acid which it contains. The price of superphosphate is determined by the quantity of phosphoric acid soluble in water indicated in the guarantee certificate, and that of potassic salts by the quantity of potassium soluble in water. As regards fertilisers containing nitrates and ammoniacal salts, their content in nitrogen must be indicated. When selling oil-cakes, the vendor must guarantee their content in fats, crude protein and ash. The guarantee certificates for bran and other milling or distillation refuse as well as those delivered for mixed foods, should indicate the quantity of non-nitrogenous extracts. The regulation also orders that the guarantee certificates shall not contain other data than those indicated in the regulation.

If the purchaser of fertilisers or cattle foods desires a second analysis made of the goods which he has bought, to verify the indications on the guarantee certificate, he should have a sample taken by two trustworthy and unexceptionable persons within a period of 14 days after the consignment of the goods and send this sample for analysis to the Government laboratory of agricultural Chemistry. The sample must be taken, in conformity with the orders in force, drawing up a written statement in duplicate.

If the analysis made by the Government laboratory of agricultural chemis

try shows a smaller content than that which was guaranteed, the vendor is liable to pay compensation, in case the difference between the ascertained content and that which had been guaranteed exceeds the limits fixed officially for discrepancies of analysis (delivery allowance). For the sake of example, we quote the following discrepancies of analysis: — for phosphoric acid soluble in a 2 % solution of citric acid of Thomas slag a deficiency of 0.60 % is admissible; for the phosphoric acid contained in other phosphatic fertilisers the difference may be 0.50 %; for nitrogen of cyanamides 0.50 %; and for other nitrogenous fertilisers 0.25 %. The content in crude protein and in fats of oil-cakes and mixed foods may only be from 2 to 1 % less than that which was guaranteed. The guarantee certificate will indicate the price of the fertilisers proportionally to the price per kg. of the integral parts which determine its value.

Some of the more important prescriptions of the law in question may also be mentioned. In the first place any one producing or importing fertilisers, cattle foods or other products used on farms, is required to declare it in writing to the central bureau of agriculture giving at least one month's notive before the said goods are placed on the market or before starting to produce them; he must declare on that occasion what the goods are, which he wishes to import or produce.

Also the prescription is very important which authorizes the Ministry of Agriculture to prohibit the production, importation and trade of fertilisers, cattle foods ad other products required by the farmer, which may be injurious or inefficient. Equally important is the prescription in virtue of which names of fertilisers and cattle foods must not in any way mislead the public.

The administration of the law is confided to the central bureau for agriculture and the Government laboratory of agricultural chemistry. This laboratory was founded simultaneously with the coming into force of the law which has just been briefly reviewed. The Government Laboratory of agricultural chemistry at Helsinki is the principal control station for the whole of Finland. It originated in the first control laboratory of Finland mentioned above which also has become a Government institution. The old Laboratory was abolished in February 1924, to be immediately replaced by the Government laboratory of Agricultural chemistry, which began to function without delay. Immediately after this reorganisation of the principal control station, the laboratory was considerably enlarged and furnished with all modern apparatus and installations necessary for chemical analyses.

From the beginning the new laboratory was managed in such a way as to be able to make several thousands of analyses a year, for an increase in the number of samples sent in for analysis had to be expected with the regulation of the trade by the new law. This expectation has indeed been fully realized. In 1925 the number of samples analysed exceeded 3000, of which 811 were samples of fertilisers and 1464 samples of cattle foods.

The Government laboratory of agricultural chemistry has appointed sworn experts for taking samples at the maritime ports and other places important for the fertiliser and cattle food trade in various parts of the country. At present these sworn experts number 12, and they are authorized to take samples of fertilisers and foods, in conformity with rules made for this purpose, at the

request of importers, manufacturers or vendors. Each general sample taken is divided into three lots one of which is sent to the Government laboratory of agricultural chemistry.

The principal tenour of the present Finnish legislation regarding the chemical control of agricultural products has been described above. It will be seen that the Finnish law is rather too liberal than too severe. The legislation still leaves something to be desired on some points and consequently the management of the Government laboratory of agricultural chemistry, the President of which is Dr. J. VALMARI, Professor of agricultural chemistry at the University of Helsinki, has prepared a draft amendment aiming at the improvement of the present regulations.

As this draft has not yet been approved by the competent authorities and as the final form which it will take has not yet been determined, only certain fundamental principles of the provisions which it contains can be mentioned.

The draft begins by defining the legal designation of fertilisers and as cattle foods. It determines in detail the requirements which fertilisers and foods placed in the market must satisfy as regards quality. Then, it is proposed to make the taking of samples obligatory for parcels of fertilisers or cattle foods imported or produced, when they exceeds 1000 kg. According to the amendment firms which trade in fertilisers or cattlefoods must adopt a system of book-keeping in conformity with instructions of the Bureau of agriculture. In most cases the amendment differs but little from the present regulation, which is due to the fact that the fundamental law is maintained without change.

May I be permitted on this occasion to declare that it would be very desirable for the International Institute of Agriculture at Rome to investigate the urgent question of methods of analysis from an international point of view. As far as is known, there is not at present any method of analysis universally recognised that may be applied for international relations. In fact, the regulations for methods of analysis of fertilisers and foodstuffs applied for international relations which were established by the Vth International Congress of applied chemistry in 1903 at Berlin, are already out of date. It is to be hoped that it will be possible to attain also greater uniformity of principles in accordance with which the value of fertilisers and cattlefoods is determined. This wish relates especially to the determination of prices of phosphatic fertilisers.

APPENDIX IV.

THE SCANDINAVIAN SOCIETY OF AGRONOMY

by Professor C. A. H. VON FEILITZEN, Stockholm, Sweden.

The Scandinavian Society of Agronomy was founded in 1918 at Stockholm. Its object is to bring together all agricultural experts and those interested in agricultural research, and to encourage agricultural research in the four Scandinavian Countries :— Sweden, Norway, Denmark and Finland.

The Society has now 1230 members of whom 422 represent Sweden, 253 Norway, 288 Denmark, and 267 Finland.

The Society publishes a monthly bulletin called Nordisk Jordbruksforskning, it includes eleven sections, namely :—

(1) for researches on garden plants
(2) » seeds and seed tests
(3) » genetics
(4) » plant pathology
(5) » agro-geology
(6) » agricultural economy
(7) » cattle breeding
(8) » experiments on fertilisers and improvements
(9) » tillage and drainage
(10) » forage crops and pastures
(11) » experimental technique and mathematics applied to calculations of experiments.

Up to the present the Sociey has held 2 congresses, one in 1921 at Copenhagen and the second in 1923 at Gottenburg, and this year the 3rd Congress is going to be held in Norway at Oslo.

Section 8 for experiments on fertilisers should be very interesting to the international Commission. The section has 78 members. Since the section was founded I have had the honour to be the President. A Commission for the standardisation of experiments on fertilisers was elected in 1920, on my proposal, with one member for each country (2 for Denmark). I was elected President of this Commission, and out of its members are present here from Denmark Dr. HARALD CHRISTENSEN and from Norway Professor LENDE-NJAA. The two others are organisers of agricultural societies, M. K. KRISTENSEN in Jutland, Denmark, and Prof. A. RINDELL at Abo, Norway.

The Commission has worked out standard plans for fertiliser experiments which wese accepted at the Copenhagen Congress (1921) and published in the report of the Congress. In November last the Commission also elaborated plans for conducting experiments on fertilisers and liming. This standardised plan is now adopted in Sweden, Denmark, Norway and Finland, and we have found it a great help for agricultural research. I only wish to tell you that last year about 1400 fertiliser experiments were made in Sweden, and over 2000 similar experiments in Denmark. The aim of standardisation is to give the greatest possibility of confidence in results. The work in the field is done by the organisers and their assistants who measure the plots, examine the soil, the fertilisers and everything. All the notes collected relating to the site and soil and the weights of the crops are made by them.

These tests are made on a large scale and repeated at least 4 or 5 times. We have plans for the different crops and the various types of soils, as well as for various fertilisers. The method used is published with details in the Congress Report of the Society at Copenhagen, 1921 : it will be found on page 454.

I can also tell you that section 11 of our Society, which is the section for technical experiment and applied mathematics, has elected a committee to prepare a mutual plan for making experiments on manuring and varieties, in the first place with oats.

The President of this committee is Professor BONDORFF of the Agricultural College of Copenhagen.

We have quite recently arranged the details and we want to start this year with experiments on nitrates in different doses in 15 centres in Sweden and as many centres in Denmark, Norway and Finland.

This is very interesting work and we have found already by earlier experiments that the different varieties of oats have actually different capacities for absorbing and utilising the fertilisers which are given to them.

If you are interested in details of the work of the standardisation committee of the Scandinavian Society, I will give you them with pleasure in a communication to the International Review of Agriculture of the International Institute of Agriculture in German.

The name of the Society is in French " L'Association des agronomes scientifiques scandinaves ", and in German " Verein zur Förderung landw. Forschung in den Nordischen Ländern ".

The official name of the Society is " Nordiske Jordbruksforskares Forening" and its office is in Copenhagen, where its General Secretary Mr. LUNDING lives.

GENERAL NOTICES.

N. B. — Starting with the next number the proceedings of the International Commission for the Study of Chemical Fertilisers will appear in three sections on the analogy of those of the International Society of Soil Science, of the International Seed Testing Association, of the International Association of Poultry Breeders etc.

The first will consist of original articles and general information by acknowledged experts dealing with actual questions on fertilisers.

The second will consist of notices and bibliography based on the originals dealing with important publications in every part of the world on fertilisers and their use.

The third will deal with matters of general interest and will give information on the state of the markets and on the most important events in the sphere of International fertilisers.

CURRENT NOTICES

Legislative and Administrative Measures.

430. **The International Agreement for the establishment in Paris of an International Bureau of Epizootics, approved 25 January 1924.**— By a law passed in March last, the President of the French Republic has been authorized to ratify and in case of need to give effect to the above agreement, signed 25 January 1924, by the following nations: Argentina, Belgium, Brazil, Bulgaria, Denmark, Egypt, Spain, Finland France, Great Britain, Greece, Guatemala, Hungary, Italy, Luxemburg, Morocco, Mexico, Principality of Monaco, Holland, Peru, Poland, Portugal, Rumania, Siam, Sweden, Switzerland, Czechoslovakia, Regency of Tunis

431. **Brazil: Regulation of the Forestry Service.**— The decree on this subject, referring to the law of 28 December 1921, takes into account in the order given the purposes of: the forestry service, the administration of this service, inaccessible forests, forest nurseries, the model forest, forestry control, forest statistics, forest reserves, national parks and forest police. For each of these subjects there is a corresponding heading in the decree, and in this way there is a ruling for every detail connected with the forest resources of Brazil. (International Institute of Agriculture. Legislative Texts, 1925).

432. **Spain: A Legislative Forestry Index.** — Ing. ENRIQUE DE LAS CUEVAS has published this 'Legislative Forestry Index' which contains all the official provisions and the judicial pronouncements made on forestry question, as also on special questions connected with these: river fisheries, water, mining, electrical installations, forced expropriations, etc., all entered in order of date in the chronological index. There is also an alphabetical index making possible a quick reference to any part of the subject Enquiries to the Imprenta de la Viuda de M. Aguaron, Huexa. Price ten pesetas, 553 pages quarto.

433. **France: Repression of Fraud in the Fertiliser Trade.** — Regulations have been issued for the application of the laws of 4 February 1888 and of 19 March 1925 relating to these frauds. The special features of this new legislation on the subject are as follows: (*a*) reinforcement of the measures already contained in the law of 1888, relating to the obligation for the seller to furnish the purchaser with all the information of value on the nature and on the place of origin of the fertiliser, the percentage and the origin of the active elements which it contains and the way in which these elements are combined; (*b*) suppression of the sale of the fertilisers, with fixation of the price in relation to the results of analysis; (*c*) express confirmation of the

right of intervention of the municipal authorities for enquiry into and ascertainment of frauds. (*Journal Officiel*, 7-8 June 1926).

434. **France: Morocco: Encouragement of Agriculture.** — A decree of 20 March 1926 has fixed for the current year the rules under which a bonus of 50 francs is to be given for every hectare of land cleared and ploughed, as a preliminary measure, to the depth of at least 15 cm. The minimum area to be cleared and broken up has been fixed at 5 hectares. The total value of the bonus awarded to one and the same farmer in the course of the year may not exceed 10,000 francs.

Another Vizirial decree of the same date, 20 March 1926, regulates the awarding of a bonus, not to exceed 4000 francs, to persons who can bring evidence to show that they have bought in 1926 one or more new agricultural tractors with apparatus for the mechanical cultivation of quite new land, ploughs to be excluded. The bonus is at the rate of one tenth of the customs value of the imported machinery. (*Bulletin Officiel*, No. 701, 1926).

435. **Morocco: Uniform Regulation of Sales and Deliveries of Cereals.** — An enactment for this purpose has been prepared and issued by the Association of Moroccan Dealers and Exporters at Casablanca. It includes 57 articles, grouped under three main headings relating respectively to: the selling unit of the cereal (metric quintal) and the weight of the bags; the deliveries, ascertainment of the weight of the respective deliveries in bags of a uniform capacity: the ascertainment of the quality of the goods and of the chaff, the guarantee of the specific weight. (*Feuille de Renseignements de la Direction générale de l'Agriculture, du Commerce et de la Colonisation du Maroc*, No. 7. Rabau, 1926).

436. **Morocco: Regulation of Game Reserves.** — Fixed by the decree of 18 February 1926 of the General Director of Agriculture, Trade and Colonisation. (*Feuille de Renseignements de la Direction générale de l'Agriculture, du Commerce et de la Colonisation*, No. 7. Rabat, 1926).

437. **Great Britain: Protection of Trade in Agricultural Products.** — The Ministry of Agriculture has given notice that arrangements have been made for the inspection, on application, of apiaries where bees are raised for sale. Where no brood diseases are found to be present in an apiary, an official certificate to that effect is given. For the present, it will not be possible to include Acarine disease in the scheme, and the certificates will relate solely to freedom from brood diseases, though they will not be issued for apiaries where Acarine disease is seen to be present The frames containing the combs of the colonies that are passed on inspection will be stamped to that effect, thus affording protection to the purchaser. (*The Journal of the Ministry oy Africulture*, Vol. XXXII, No. 12. London, 1926).

438. **Greece: Repression of Frauds in Flour.** — A decree law of last January has fixed the conditions to which flours imported from abroad into Greek territory must conform, with a view to maintaining their purity and their capacity for making wholesome bread. These provisions are substituted for those of the regulation of 25 March 1925, on imported flours. (*Annales des Falsifications et des Fraudes*, No. 207. Paris, 1926).

439. **Guatemala: Forestry Legislation.** — Legislation has been applied to questions of sylviculture in this country also. All wooded areas belonging

to the State or to the communes, and also to corporations and to private persons, have been placed under government control. The various forestry areas have been divided for administrative reasons into : *a*) the bala region supplying the " *chicle* " and including the departments of Paten and the southern district ; *b*) the mahogany region, which includes the territories stretching from the sea level to 1500 feet ; *c*) the cotton region, up to an altitude of 2000 feet ; *d*) the coffee region, up to 5000 feet ; *e*) the pine region above 5000 feet. Each region is then divided into sections according to the forest species and the hydrographic system.

The law deals under separate heads with : the forest property of the State ; forest concessions ; felling of trees ; extraction of gums, resins, tanning materials. dyes, forest industries ; the Arbor day planting ; forest police and forest fires, (*El Guatemalteco*), No. 86, 1925).

440. **Italy : Extension of Fruit-growing and Horticulture in the Ager Romanus.** — By a decree of the Minister of National Economy bonuses are given to land owners, lease holders, tenants, etc., who, in the three years 1926-1927, 1927-1928, 1928-1929, have planted not less than one hectare of orchard specialised for industrial purposes or of vineyards for table grapes or of olive yards. The bonuses are fixed at the rate of 25 % of the expenditure actually incurred and in any case not more than Lire 6000 per hectare. Field crops of vegetables are allowed in association with the orchard, vineyard or olive yard, provided the necessary precautions are taken against damage to the plantations.

Premiums of 200 to 800 liras per hectare have also been arranged for planting of watered or dry farmed market gardens in the administrative area of the Commune of Rome.

441. **Italy : Assistance to the Anti-Malaria-Campaign.** — The Government has arranged to admit duty free the residues of the distillation of mineral oils, when intended for the destruction of the larvae of the malarial mosquito. (*Gazzetta Ufficiale*, No. 93, 1926).

442. **Portugal : Legislative Measures for the Prevention of Development and Diffusion of Plant Diseases.** — In virtue of these the Government agricultural and forestry centres, agricultural schools, agricultural stations, forestry departments, etc., carry out measures of prophylaxis within a given area, and, after making careful examinations and taking samples, they report, from time to time, to the Laboratory of Plant Pathology of Verissimo di Almeida or to the Laboratory of Forest Biology. These two establish ments are empowered to issue provisions for the preventive and curative treatment of the disease as ascertained, and to carry out suitable experiments, as may be necessary, either, on infected or infested estates or on an area at Tapada de Ajuda placed at the disposal of the Laboratory of Plant Pathology. The cost of carrying out the measures officially ordered in the different cases must be met by the respective landowners. (*Diário do Govêrno*, First Series, No. 224, 1925).

443. **Portugal : Agricultural Exchanges.** — All the Portuguese Government Services, established for the purpose of regulating trade in agricultural products and by products, have been centralised into a single department of ' Agricultural Exchanges '. It consists of a Secretariat, a Division

of Commercial Services and a Division of Public Consumption. The Secretariat is in its turn divided into two parts: (*a*) administrative, (*b*) arbitration or appeal section. This the Commercial Division contains two sub-sections: (1) information and propaganda, (2) commercial; which last the division of Public Consumption again has two parts: (*a*) provisioning, (*b*) inspection of agricultural products.

The Department of Agricultural Exchanges is establishing: 1. warehouses for storage and for movement of goods, equipped for the purpose with loading, unloading and weighing apparatus; 2. a depot for reception and classification of samples; 3. collections of samples of foodstuffs for the information of persons interested; 4. retail depots; 5. other subsidiary installations considered necessary. (*Diário do Govêrno*, First Series, No. 117, 1925).

444. **Switzerland: Measures relating to Wine.** — By a new ordinance of February last on the trade in foodstuffs, an explicit definition is given of the meaning of wine, and it is forbidden to employ in the wine trade fancy denominations likely to mislead the public as to the origin of the product. Indications in regard to origin (town or village, region, farm or vineyard), method of wine making, year, degree of alcohol, must be in accordance with the true state of affairs and exclude any possibility of confusion or error. It is forbidden to make use on the invoices, on stakes or labels, of any generic terms, such as 'type', 'brand' or 'kind', in reference to an indication of origin. The proportion of sulphates and of sulphurous anhydride which should be contained in the wines placed on the market is fixed by this Order. The new order replaces that of 8 May 1924.

Experiment Stations and Agricultural Instruction.

445. **Germany: Farm Experiment Clubs among the farmers of small or medium sized holdings in Wurtemberg.** — These clubs date from 1925 and were started at Herrenberg, Biberach and Heilbronn.

In order to have expert direction of these clubs provision was made for six of the most proficient of the ex-students of the winter schools of agriculture to pass into the Provincial Experiment Sowings at Hohenheim, so as to take a year's apprenticeship in experimental work. Future provision will be made in the same way, six former pupils of the schools mentioned to be taken each time. The Experiment Clubs thus formed are under the Local School of Agriculure and through that come under the Provincial Chamber of Agriculture which, makes financial provision for them. As well as the head farmer of the club, certain owners of agricultural land in the respective districts act as presidents. The expenses for each club annually amount to 2500 marks.

The object of the promotors of this scheme, which was to increase the number of field experiments seems to have been satisfactorily realized. (WEISS. Entstehung, Organisation und Entwicklung des bauerlichen Versuchsringwesens in Württemberg). (*Mitt. der Deutschen Landwirtschafts-Gesellshaft*, No. 14, 1926).

446. **Germany: Occasional Publications of the 'Biologische Reichsanstalt'.** — The State Institute of Biology (Biologische Reichsanstalt) has placed on sale its publications from time to time on the control of plant di-

seases and pests, They are collected into two sets: (*a*) control measures for field crops and forests; (*b*) treatment of market gardens and vineyards. Each set contains 40 pamphlets, with index: price 2 RM. To be obtained from the Biologische Reichsanstalt, (Postsheckkonto Berlin, No. 75 or from the *Landesanstalt für Pflanzenbau und Pflanzenschutz*, Munich, Bavaria, Liebigstrasse, 25 (*Praktische Blätter für Pflanzenbau und Pflanzenschutz*, Year IV, No. 3. Freising, 1926).

447. **Germany: Academy of Domestic Science.** — Under the name of *Central für Hauswirtschaftswissenschaft*, a new section of the Berlin *Akademie für soziale und pedägogische Frauenarbeit* has been formed. This is the first attempt in Germany to raise to academic status the subject of domestic science.

The headquarters of the new Section is at the School of Agriculture (Berlin, No. 4, Invalidenstrasse 42).

448. **United States: A National Arboretum of the Department of Agriculture.** — The American Senate has approved the proposal providing for the purchase of the Mount Hamilton area near the Anacostia River, where it is intended to make a Federal Arboretum, and the sum of 300,000 dollars has been assigned for the purpose. (*Science*, Vol. LXIII, No. 1638).

449. **Canada: Faculty of Forestry of Toronto University.** — This faculty is now fully established. A special building, set apart for it, contains all that is essential for instruction and for forestry research: museums, library, laboratories, etc. The inaugural ceremonies took place on 19 to 21 January, and during the three days there were also held the annual meetings of the Canadian Society of Forest Engineers, the Canadian Forestry Association and the annual conference of the Ontario Foresters. (*Journal of Forestry*, Vol. 118, No. 3. Washington, 1926).

450. **United States: The Brooklyn Botanic Garden. N. Y.** — This institution is one of the leading scientific and educational institutions of New York. The Annual Report of the work of 1925 gives the figures of visiting classes from the public and private schools as over 58,000, while the attendance at the Botanic Garden classes was 30,000. Plant material has been supplied to over 2.200 teachers in the city schools, in quantity sufficient for the instruction of over 162,000 pupils. The Brooklyn Garden is in correspondence with 110 foreign gardens and a very considerable exchange of seeds has taken place. The plants raised from these seeds are annually enriching the plantations and have made the collection at the Brooklyn Garden one of the finest in respect of the number of varieties in the United States.

Special attention is called in the report to the effective work which the Botanic Garden is doing for wild flower conservation, in co-operation with other organizations: to the investigations in plant breeding, plant diseases and the vegetation of Long Island. The Director also calls attention to the disastrous effect on the trees of the garden and of all the city parks by the soot and fumes produced by the burning of oil and soft coal.

The Garden is also rendering an increasingly large service to industrial and commercial concerns through its bureau of information.

The Library receives over 800 periodicals from all parts of the world. (*Science*, Vol. LXIII, No. 1638. New York, 1926).

451. **United States: Missouri Botanical Garden.** — From the 37th report lately issued by the Director of this Garden and referring to 1925, it appears that a new site for an extension has just been acquired of about 1300 acres near Gray's Summit, 38 miles from St. Louis. It will thus be possible to grow plants which could not thrive in the city, and more particularly the magnificent collection of orchids will benefit from the change.

The report gives some account of the general activity of the Garden, both as regards the courses of instruction given and the experimental work. The investigations relate to plant breeding, and plant diseases, as well as physiology, cytology, chemistry and bacteriology. Special enquiries have been made into the subterranean algal flora, the smoke content of the atmosphere of St. Louis, etc. The report also emphasizes the steady growth of the herbarium, and of the library both of which sections are in constant use, alike by the staff and students and also by visitors from all parts. (*Missouri Botanical Garden Bulletin*, Vol. XLV, No. 1, St. Louis. No. 1926).

452. **United States: The Commercial Museum Philadelphia.** — This institution is devoted to the general extension of international commerce and the dissemination of information regarding the commercial products of the world. It is maintained by the City of Philadelphia, the State of Pennsylvania and by private subscriptions from business firms in the United States. It is a centre of such information and is in close touch with business houses all over the world, and an aid in opening up new markets for all useful natural or manufactured products. Its organization dates back to 1894 and it is managed by a Board of Trustees. The collection is rich in every kind of product from all regions of the world and is of high educational value. In 1924 it was visited by 34,907 pupils of the Pennsylvanian schools, and sixty-six illustrated lectures were delivered in these schools. The Museum material is also used for educational exhibits and a rich library amounting in 1924 to 48,353 volumes and 89,000 leaflets is available for readers. A special section of the institution known as the Foreign Trade Bureau is engaged as the name indicates in international commercial relations.

In 1924 the financial statement of the year showed that operations covered a sum of over 200,000 dollars. (*Report of the Philadelphia Museums. The Commercial Museum.* Series 1, 1924. Received at the International Institute of Agriculture in the current year).

453. **United States: Department of Tropical Research of the New York Zoological Society.** — This Society had nine years ago instituted a Tropical Research Department, which carried on from the beginning many and valuable enquiries in particular on the biological side. It has been especially active in 1925 and in *Science* (Vol. LXIII, No. 1638. Washington I, 1926) Prof. WILLIAM BEEB of the New York Zoological Park gives a full account of the work of this Department.

454. **Haiti: Demonstration Farms.** — The agricultural agents at Cayes, St. Marc and Gonaives recently held a conference in Port-au-Prince with the chief agricultural expert to work out plans for the improvement of the several demostration farms under their supervision. Several contracts for demonstration farms in the Jacmel district have been arranged, in the Jérémie district at Marfranc a farm school has been located, and in that district too

active work has been done in teaching farmers to harvest their coffee with less damage to the plants than hitherto. (*Bulletin of the Pan-American Union*, January 1926).

455. **Trinidad : Imperial College of Tropical Agriculture.** — Dr MARTIN LAKE, director of this College, has published a report on the work during the session 1924-25, the third academic year of its life. The report bears witness to a remarkably vigorous development. In the course of the year, the first students completing their three year degree course have graduated with success. In addition to the teaching work undertaken by the staff, research and investigation has gone on into the cultivation of bananas, the sugar cane, cotton, tobacco and other plants. Studies in soil science, bio-chemistry and plant diseases have also been made. (*Tropical Agriculture*, Vol. III, No. 4. Trinidad, 1926).

456. **Hawaii : Agricultural Experiment Station.** — This Federal station which has headquarters in Honolulu has divided its work into different sections, agriculture, horticulture, chemistry and propaganda. It distributes improved and selected varieties of plants, and from the date of its foundation (1901) it has conducted numerous enquiries into the most varied agricultural problems. The results of these researches have been and are being collected in the Bulletins of the Station numbering about 200 issues. The Station is under the control of the Office of Experiment Stations of the U. S. Department of Agriculture. At the present time the director is Prof. J. M. WESTGATE. (*Journal of the Pan-Pacific Research Institution*, Vol. I, No. 1. Honolulu, 1926).

457. **Hawaii : Sugar Planters' Experiment Station.** — This is a private institution which from a modest beginning, in 1895, has had a vigorous development and is now organized in six sections : 1. *Entomological Section* which exercises control of insects injurious to the sugar cane, mainly by the introduction into the plantation of other insects which prey on the pests ; 2. *Pathological Section*, which studies the diseases to which the sugar cane is liable and co-operates with the other branches in the control of these diseasess ; 3. *Agricultural Section*, the object of which is the diffusion of new varieties of and the study of methods of cultivation ; 4. *Forestry Section*, which collaborates with the Government forestry officials on questions of irrigation ; 5. *Technological Section*, which collaborates with the chemical section in the supervision of the plants which elaborate and transform the sugar cane ; 6. *Chemical Section*, which conducts investigation of land which is to be devoted to sugar cane plantations. (*Journal of the Pan-Pacific Research Institution*, Vol. I, No. 3. Honolulu, 1926).

458. **France : Temporary School of Sericulture at the Montpellier National School of Agriculture.** — This was formed last spring, particularly with the idea of offering facilities for improvement in theory and technique to owners of sericultural establishments, directors of seed nurseries, and any other persons who devote themselves to the study of the silk worm. The courses naturally include lectures, practical work in the laboratory and the silkworm rooms, and excursions to the silk producing districts and to different establishments for the rearing of the worm and the production of seed. (*Bulletin de l'Office de Renseignements agricoles*, No. 7, 1926).

459. **France : Agricultural Problems treated by French Agricultural Engineers.** — The "*Association Amicale des Anciens Elèves de l'Institut National Agronomique*", also known as the "*Association des Ingénieurs Agronomes*", which has been in existence for about 60 years and has a membership of about 2000, has initiated a series of enquiries in the various fields of agricultural studies. The work is being divided between groups of members, according to special competence in the different subjects.

The President of the Association, EMILE SAILLARD, has selected for the purpose about 15 collaborators, and a brief report has been compiled by each of these on the progress made in the branch which formed the subject of their respective enquiries. The reports have since been published in one volume, divided into four sections: I. Rural Economy; II. Agriculture; III. Rural Engineering, Forestry, Horse-Breeding; IV. Agricultural Industries.

There are in all sixteen reports, concise but clear, some of which deal with questions deeply engaging the attention of agricultural technicians, such as the electrification of the country districts, mechanical traction of special sorts, seed testing and the employment of selected seeds, the manufacture of synthetic nitrogenous fertilisers, etc.; all reports bearing well known names in the field of agricultural science: PREAUD, JAGERSCHMIDT, DE SEYNES, BUSSARD, HITIER, etc. (*Les problèmes agricoles traités par des Ingénieurs agronomes*, No. 1, pp. 128, in small octavo; Paris, 1926).

460. **France : Course of instruction in Cider-making at the Caen Pomological Station.** — This was a ten days course taking place in June last and the objects were: (*a*) to impart theoretical and practical knowledge relating to the making and conservation of cider; (*b*) to make known the most essential methods of combining the ingredients by careful testing of the raw materials and of the manufactured products (proportions of the sugars, of the various acids, microscopic examinations, etc.). (*Bulletin de l'Office de Renseignements agricoles*, No. 8. Paris, 1926).

461. **France : Besse Biological Station, Puy-de-Dôme.** — This station is affiliated to the Faculty of Science of the Clermont University, and lies at an altitude of 1050 metres in the volcanic region of Monte Dore, close to the district of the Lakes of the Auvergne at the foot of the massif of Sancy in an area of forests and pasture land. It is thus especially well placed for studies of the classification, the distribution, and the biology of the plant and animal life of the lakes, the peat bogs and the mountains, as also for scientific work applied to zootechnical or sylvicultural questions.

The Station was opened to students this year and is to remain open from 15 June to 1 October. A certain number of rooms are available, with some accomodation for married persons, and meals can also be obtained at moderate prices. For information apply to the Director of the Station or to his assistant M. DENIS, botanical demonstrator, in the Science Faculty at Clermont (*Revue Générale de Botanique*, Vol. XXXVIII, No. 447. Paris, 1926).

462. **Great Britain : Official Seed Testing Station for England and Wales.** — According to the Eighth Annual Report on the work of the Station during the period August 1924-July 1925, the number of samples received for testing was 21.894, showing an increase of 3008 as compared with the preceding period. There was an increase of 100 per cent. in the number

of farmers sending samples for testing and an increase of 29 per cent. in the number of seed firms making use of the Station for the same purpose. An analysis of the samples shows that they include 9,066 samples of cereals, 1,891 of pulses, 4,148 of roots and vegetables, 4,283 of clovers, 2,334 of grasses, and 172 of miscellaneous seeds, including tree-seeds and linseed. The increase in the number of samples over the previous season is 30 per cent. in the case of clovers, 18 per cent. in the case of grasses, 16 per cent. in the case of cereals, and 13 per cent, in that of pulses.

The report appears in No. 5 of the " Journal of the National Institute of Agricultural Botany " copies of which may be obtained from the Institute at Huntingdon Road, Cambridge, price 1*s*, or 1*s*. 2*d* post free. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

463. **Great Britain : Research Laboratory for Fruit and Vegetable Preservation, London.** — The Secretary of the British Department of Scientific and Industrial Research announces that the Department has recently organized a small research Laboratory at Dudley House, Endell Street, in the vicinity of Covent Garden fruit and vegetable market. The laboratory will work in close connection with the Low Temperature Research Station, Cambridge, which is the head quarters of the fruit and vegetables section of the Department's organisation for food investigation. The object of the laboratory at Covent Garden is to bring the Station into closer contact with the trade in fruit and vegetables, and with the practical aspects of the problems of their transport and storage. (*Science*, Vol. LXIII, No. 1633, 1926).

464. **Great Britain : Young Farmers' Clubs.** — Interest in the Young Farmers' Club Movement is growing rapidly. Already forty-one counties have taken up the scheme and clubs to the number of forty-five have been successfully formed in twenty counties, with a membership to date of 1312. Negotiations are in progress in 124 centres to start new clubs. The County of East Sussex has published the first number of the " Boys' and Girls' Poultry Club Journal " for its 370 members. In Scotland, Young Farmers' Clubs have been formed in Caithness, Orkney, Sutherland and Ross and Cromarty with a membership of 85 members. All these clubs deal in a practical, interesting, commercial and up to date way with the following subjects : Beef and dairy calves, pigs, poultry, bees, rabbits (wool, fur and flesh), field crops, experiments with artificial manures, horticulture, intensive market gardening, simple cost accounting and management, public speaking and debating.

These clubs are proving to be assets of great value in both urban and rural life. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1. London, 1926).

465 **Great Britain : Publication of the Results of the Work of ths Agricultural Research Institutes.** — With further reference to thie subject to which attention was drawn in the last number of this Review (*Current Notices*, No. 254), it may be added that the fourth of the monographs published by the Ministry of Agriculture has appeared, entitled " Wheat Breeding Investigations at the Plant Breeding Institute, Cambridge ". The publication (114 pages and 30 illustrations) is the work of Professor Sir R. H. Biffen and of F. L. Engledow. Among the topics dealt with are the following : Mendelian heredity ; linkage ; chromosomes ; forms used for crossing ; ge-

neral methods of breeding and the propagation of hybrids; the yield problem; straw; lodging; rusts and the breeding of disease resisting forms; the work of the Home-Grown Wheat Committee; effect of soil on quality; effect of manuring; tests for 'strength'; the introduction of the Yeoman Wheats (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1 London, 1926).

466. **Great Britain: Electro-Culture Investigations.** — The Electro-culture Committee has presented to the Ministry of Agriculture its Eighth Interim Report, dealing with its work during 1925. Previous reports on the work which the Committee has carried out since 1918 showed that under field experimental conditions an increased yield of 20 per cent. on the average might be expected when certain spring crops were subjected to high tension discharge (10,000 to 20,000 volts), and that under both field and pot experiments electrification has accelerated reproductive growth much more markedly than vegetative growth. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

467. **Great Britain: Scholarships given by the Ministry of Agriculture.** — Seven research scholarships in agricultural and veterinary science tenable for three years are offered, worth £ 200 per annum, while extra allowances may be made for travelling and subsistence for periods abroad. In addition there are offered five tenable for two years, for the same amount as the former, intended for students who propose to take up posts as agricultural organisers, teachers, or lecturers in agriculture, etc. In addition grants for amounts not specified are offered in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year commencing October 1, 1926. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

468. **India: Creation of an Imperial Forest Service College at Dehra Dun.** — The buildings of the Forest Research Institute at Dehra Dun are to be converted into a college for students wishing to enter the Indian Forest Service. Twelve such probationers will be admitted each year, and as the course will be a two years practical course, the number of students in residence at one time in this Imperial Forest Service College will be twenty-four. It is hoped that it will be possible to open the College in November of this year. (*The Indian Forester*, Vol. LIII, No. 4. Dehra Dun, U. P. India: 1926).

469. **India: Reports on Work in Agricultural Science in the period 1924-25.** — The Government of India (Central Publication Branch) has published in one volume the Scientific Reports of the Agricultural Research Institute at Pusa, covering the work done in agricultural botany, chemistry, bacteriology, mycology, in phytopathology, entomology and cultivation methods. There are also included the Reports of the Imperial Dairy Expert, the Physiological Chemist, the Government Sugar-cane Expert, dealing mainly with questions of the breeding of varieties of cane, and the Report of the Secretary of the Sugar Bureau on agricultural, industrial, commercial and statistical aspects of sugar cultivation.

The whole is prefaced by a general and administrative report by D. CLOUSTON and C. S. HENDERSON, director and deputy director of the Institute. (Scientific Reports of the Agricultural Research Institute, Pusa; including the

reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugar-cane Expert and Secretary, Sugar Bureau, 1924-1925, pp. 163, 8vo; with appendices. Calcutta, 1925).

470. **Australia: Experimental farms in South Australia.** — The Department of Agriculture of South Australia has published in No. 193 Bulletin some records on the work done by various experimental farms in its area. Mr. ARTHUR J. PERKINS, Director of Agriculture, has drawn up the report on Turretfield Demonstration Farm which has been since July 1921 worked on purely commercial lines. The report which relates to the period 1 April 1924 to 31 March 1925 is in the main confined to balance-sheet considerations and a close analysis of the cost of various farming operations. The farm consists approximately of 1,262 acres of arable land and 327 acres of rough hill grazing, whilst about 15 acres are occupied by buildings yards, plantations, etc.

Mr. L. J. COOK, Manager, is responsible for the report on the dairy herd of Ayrshire cattle belonging to the Kybybolite Experimental Farm. These pedigree and graded cattle were purchased some time previously in Victoria, forming the nucleus of a herd intended to test the possibility of the district for dairying. The climatic conditions and the natural forage of the district led to the choice of this hardy Scotch breed, and they are continuing to prove that they can stand very well the comparatively cold and wet winter conditions of Kybybolite.

Another reports has also been drawn up by Mr. COOK on the crops obtained on the same farm which covers an area of about 100 acres in the Hundred of Binnum.

Mr. W. J. SPAFFORD, Chief Agricultural Instructor and Mr. S. C. BILLINGHURST, Manager, have drawn up a report of the Eyre Peninsula Experimental Farm chiefly dealing with the crops obtained in 1924. This farm consists of 3041 acres including 1200 of arable land. The greater part of the farm will also be capable of convertion into arable land after removal of the natural growth.

The Booborowie Experimental Farm covers 1484 acres and is situated 120 miles north of Adelaide at an altitude of 1200-2000 feet. In lies in the centre of a very good district which contains land: (1) suitable for cereal growing, (2) for clover without irrigation (and lastly, 3) some first class natural grazing land. The report on this farm is made by the Manager, Mr. E. A. BRISTOW.

This Departmental Record also includes a report by Mr. L. SMITH, Manager of the Veitch's Well Experimental Farm. This farm is situated in the Hundred of Allen, 158 miles from Adelaide and consists of about 3800 acres, the bulk of which is sandy. (Department of Agriculture of South Australia. Bulletin No. 193. *Records of some Departmental Work*. Adelaide, 1925).

471. **India: Calendar of the Forest Research Institute and College, Dehra Dun.** — A new edition of this Calendar has just been issued containing a short account of the College and its history, regulations for the various courses for forest officers with their respective syllabuses. Application may be made to the Manager; Government of India, Central Publication Branch, Calcutta, Price, Rupees 5, annas 6.

472. **Australia: The Waite Agricultural Research Institute, South Australia.** — This Institute has been founded by the University of

Adelaide for the purpose of carrying out agricultural experiments and enquiries. Its establishment was made possible by a bequest of £ 100,000, which the late Peter Waite, a large sheepowner, left for the purpose to the University. The South Australian Government has supplemented this endowment by a annual grant of 5,000 pounds sterling. The Institute is situated in Glen Osmond, $3^1/_2$ miles from Adelaide on an area of 300 acres of fertile land. The research work will be carried on in respect of agricultural science in general and in particular agricultural chemistry, phytopathology and plant breeding. (Communication made to the International Institute of Agriculture by the Board of Management of the Waite Institute).

473. **Italy : The Turin Station of Agricultural Chemistry.** — The " Notiziario Chimico-Industriale " which was first issued in January of this year has a special column giving information on the Italian Chemical Experiment Stations. In No. 3, March 1926, there is a notice of the Royal Station of Agricultural Chemistry at Turin, which is one of the most complete in Italy and is at present under the direction of Prof. FRANCESCO SCURTI. It is divided into five sections relating respectively to : (*a*) research work ; (*b*) analysis ; (*c*) adulteration ; (*d*) the agricultural industries ; (*e*) questions of agricultural science.

The first or research section is engaged on the various questions relating to the improved utilisation of agricultural land and is of a definitely experimental nature. At the present time some of the problems under consideration form part of a vast programme agreed upon at a congress of the Agricultural Experiment Institutes, held in Rome on 3 February 1925. Such for example is the enquiry into *soils with irregular rotation*, which involves the systematic examination from the point of view of their acidity or alkalinity of all the soils of Italy, the Turin Station undertaking the enquiry into the soils of Piedmont, Liguria and Northern Sardinia ; the enquiry into the *general composition of soils for the compilation of the agro-geological map of Italy* : the *enquiry on phosphatic fertilisers*, etc. For these studies the Station possesses the most modern equipment of scientific instruments and has in addition an excellent specialised library.

The second section, dealing with analyses performs an important service for the public and every year thousands of agricultural products and by-products are examined. With a view to securing rapidity and precision, a special building is available for this Sectiou, in which each room is organised for a given class of product, analysis of phosphatic fertilisers, electro-chemical analysis, etc.

The third or adulterants section keeps special watch over the adulteration of the various agricultural products, and in view of the extension of vine growing in Piedmont, carries on a continuous investigation of all the musts and natural wines of the provinces of Turin and Novara. Two special departments ore respectively engaged on the œnological examinations and on examinations af fats and oils.

In the fourth section, that of the agricultural industries, a study has been made of the problems especially involved in the preservation of agricultural products, the scientific utilization of the residues of the rural industries, the purifying of the different products, etc. The large experimental equipment of the Section makes it possible to carry on investigations on a scale which is

semi-industrial. In addition to other mechanical appliances it possesses a refrigerating plant of improved type, of 10,000 freezing unit power, and a large desiccator on the Passburg system.

The fifth or agricultural science section has been recently established and has the use of an experimental holding of about 8 hectares. At the present time, research is being conducted here as also at the Royal Station of Agricultural Chemistry at Rome and at the Portici Laboratory of Agricultural Chemistry, on the influence of light on the growth of cereals. (*Il Notiziario Chimico-Industriale*, Year 1, No. 3. Turin, 1926).

474. **Italy: Work of the Royal Experiment Station, Reggio Calabria, in connection with the Manufacture of Essences and Derivatives of Citrus Fruits.** — For several years measures have been taken to encourage the essence industry in Calabria and Sicily, and to direct the cultivation of those plants which together with citrus fruits are of importance to the perfume and other similar branches of industry. The Reggio Calabria Station has also paid special attention to the analysis of citrus fruit essences, and this work is gradually developing. In fact the number of the analyses made during the season December-April were 1500 in 1920; 2000 in 1921 2400 in 1922; 2700 in 1923; 2300 in 1924 besides other analyses of citrus juices and citrates, etc.

Parallel with these studies and researches into methods for production of essences, the Station has conducted others on the essences from the natural flora of the territory of Reggio (*Calamintha nepeta*, *Mentha pulegium* L., *Mentha acquatica* L., *Rosmarinus officinalis* L., *Origanum vulgare* L., *Artemisia arborescens* L., *Artemisia variabilis* Ten., *Inula graveolens* Desf. Detailed accounts are given in the monographs published by the Station. In 1921 the cultivation of aromatic plants was initiated in the experiment field situated in the immediate vicinity of Reggio. The various crops are as follows: *a*) plants adapted to the climatic and other conditions offered by the experimental fields and therefore making it possible to make deductions of economic value: rose, jessamine, tuberose, jonquil, hyacinth, etc.; *b*) plants cultivated for the sole purpose of multiplication and distribution to suitable Stations; thyme, hyssop, balm, marjoram, mint, sage, etc. Recently the Station has obtained another experimental field at S. Stefano di Aspromonte at an altitude of 1000 metres. In the current year the extraction by means of volatile solvents of the plant essences most prized for perfumes and most remunerative has been undertaken: orange flowers, acacia, rose, hyacinth, jonquil, etc. (*Bollettino Ufficiale della Regia Stazione sperimentale per l'industria delle essenze e dei derivati degli agrumi*, Year I, No. 1-2. Reggio Calabria, 1926).

475. **Italy: Travelling Cinema for Agricultural Instruction.** — In consequence of the good results obtained from the courses of agricultural instruction given with the help of cinematographic projections in numerous centres of Latium and in the province of Grosseto, on the initiative of the *Opera Nazionale dei Combattenti*, this institution will extend the same experiment to other regions of Italy beginning with Sardinia. The *Opera Nazionale* has had special motor lorries built, completely equipped for the projection of films in the open air, each fitted with its own dynamo, for special use in localities where the electric light is not yet installed. (From the Italian daily papers).

476. **Italy : Poultry Breeding Experiment Station.** — The Poultry Observatory and Bee Keeping Station with headquarters at Diano Marina (Imperia) will now be known as the Poultry Breeding Experiment Station (" *Stazione sperimentale d'avicoltura* "). At the present it possesses more than thirty selected breeds of poultry, bred under conditions calculated to insure purity. (*Giornale di Agricoltura della Domenica*, XXXVI, No. 21. Piacenza, 1925).

477. **Italy : Royal Experimental Station for the Food Preserving Industry Parma.** — This recently established station has a chemical and bacteriological laboratory for the discovery of frauds or defects in the elaboration of food stuffs and also an experimental laboratory in which investigations and enquiries will be carried out on an industrial basis. The work of the station will be to make generally known new products and new methods of preparation, to investigate new sources, of food supply, and to train the experts for the industry in question. (*L'industria italiana delle conserve alimentari*, year 1, No. 4. Parma, 1926).

478. **Norway : Soil Science Researches.** — In this station such researches began in 1908 on the initiative of the " Royal Society for the progress of Norway " (" *Kgl. selskap for Norges Vel* "), which consists of a soil Science Committee of 3 members with a provisory working staff. This Committee remained active till 1921, when its functions were assumed by the State, which transferred it as a government organ for soil science researches (" *Statene Jordundersökelse* ") to the Norwegian High School of Agriculture (" *Norges Landbruksho Iskole* "). Investigations have principally been made to ascertain the condition of Norwegian lands and the preliminary results are published in special bulletins (" *Jordbundsbeskrivelserne* ") that have actually reached their 23rd number. On this subject it is intended to publish a general description of the 18 counties (" fylker "). The description of the lands in the county of Ostfold is nearly finished and the study of other counties has been commenced.

Researches are also being made on particular questions such as the acidity of the soil in various Norwegian regions, published in the " Tidskrift for det norske landbruk ", and the profile of the various lands. The first part of these studies on the profiles has been published in the " 3 Nordisk Jorbrukeforskring No. 5 of 1925 and refers to the " Ostfold " region.

The Director of the " Statens Jordundersökelse " is Prof. Dr. K. O. BJORLIKKE aided by an assistant and a permanent official who is also lecturer at the Norwegian Agrarian High School. In the year 1924-25 the director had besides 8 other collaborators. In 1925 a Norwegian Section of the International Society of Soil Science was formed. It is composed of 90 members, with Prof. BJORLIKKE as president and Prof. J. LINDEMANN as secretary and treasurer. (Prof. K. O. BJORLIKKE. Beretning om Statens jordundersökelse for ärene 1924 og 1925. *Meldinger fra Norges Landbrukshöiskole*, Vol. 1-2. Oslo, 1926).

479. **Russia : Introduction of new crops into the Soviet Republic.** — The Institute of applied Botany having its seat at Leningrad, has organized a series of expeditions to tropical and subtropical countries in order to import into Russia seeds of cereals and other plants that do not exist in the Republic. Professor VAVILOV, director of the Department for Large scale Farming, v i

sited the Mediterranean archipelago, Egypt, Abyssinia, Syria, and Palestine to make enquiries into their methods of cultivation of barley, flax, beans, etc. Last year the same Professor had imported into Russia about 7000 samples of seeds from Afghanistan. Prof. BURASOV is studying the cultivation of potatoes, tomatoes, maize, the sunflower, etc., in the Western Andes (South America). Prof. VORONOV is making enquiries in Brazil in order to study the type of rubber plants that can withstand a hard climate. (*Science*, v. LXIII, No. 1637. Washington, 1926).

Agricultural and Scientific Associations and Institutions.

480. **An International Wine Bureau.** — Signor S. E. ROSSI, Italian Minister of Commerce, as early as 1916 had formed the idea of calling an international conference of the wine exporting countries. The first conference however took place in Paris from 4 to 6 June 1923 and was attended by delegates of Spain, Greece, Italy and Portugal, and was followed by a second conference also at Paris, from 30 June to 5 July 1924 at which, in addition to the States above named, representatives attended from Austria, Chile, Hungary, Luxemburg, Mexico, and Tunis. In the course of these two meetings a scheme for establishing an *Office international du Vin* was outlined. At the present time and in consequence of an international agreement dated 29th November, 1924, a bill has been brought before the French Chamber of Deputies for the approval of this agreement, establishing the Bureau in question with headquarters at Paris. (*Annales de Falsifications et des Fraudes*, year 19, No. 209. Paris, 1926).

481. **Brazil : Work of the Commissão do estudo e debellação da praga caféeira in the State of S. Paulo.** — In consequence of the alarming spread during these last few years of the beetle *Stephanoderes coffeae* in the coffee plantation of the State of S. Paulo there has been established by Law No. 2020 dated 26th December, 1924, a Commission for the study of this pest and its control. This Commission is attached to the " *Secretaria da Agricultura, Commercio a Obras Publicas*".

In accordance with the duties entrusted to it the Commission, under the presidency of Dr. Arthur NEIVA, has promptly undertaken the scientific and practical study of all the questions relating to the life history of the insect, commonly called in the country " brocha do cafe ", the immense losses caused by it, and the measures for its control.

The work so far accomplished by the Commission is recorded in a series of fifteen leaflets, fully illustrated, some of a technical character but the greater part drawn up with a view to propaganda, and diffusion of information. The control measures thus organized under the direction of the Commission have proved remarkably successful in dealing with the pest, which had threatened the most important agricultural resource of the State of S. Paulo.

482. **China : Fisheries protection in Kiangsu.** — In this province a Kiangsu Coast Volunteer Corps has been formed for the protection of the fisheries and coast navigation. The Corps has at its disposal two steamers and twenty armed light vessels. The Corps has headquarters at Woosung and will undertake experiments in regard to modern fishery methods. (*The Lingnam Agricultural Service*, Vol. 3, No. 1. Canton, 1925).

483. **France: The Archives of the Department of the Agricultural Services.** — P. DEMARTY, director of the agricultural services of Tarn-et-Garonne, has explained in the *Bulletin de l'Office de Renseignements Agricoles*. (No. 7, 1926) the way these archives are put together, starting from the principle that the extension of the services in question in the different departments of France makes necessary a systematic classification of the numerous documents relating to them. In this way uniformity and continuity of policy will be made possible for the successive directors of the services, as they will have at their disposal the records as established by their predecessors over a long period of time. The work of DEMARTY is eminently practical and deals with the formation of files, of inventories, of the practical classification of both files and lists, as also of the more bulky publications, catalogues, etc.

484. **The Sheep Union of North Africa.** — Full reports have been published by the administrative council of this society whose headquarters are at Paris on its activities in 1925. The reports show how the Association has taken very great pains to develop and modernize the methods of marketing in North Africa, and with this aim two separate societies have been formed:— "The Shearing Society of North Africa" (*Société Nord-Africaine de Tonté*), which aims at promoting mechanical sheepshearing in North Africa, and at classification and proper packing of fleeces, and "The North African Society for Public Sales" (*Société Nord-Africaine de ventes publiques*) formed for the purpose of introducing into North Africa the same system of sales by auction that have rendered such excellent service to the wool markets of the world.

The Sheep Union of North Africa has also organized special sections for Morocco, for Algeria, and for Tunisia, which are supported by the experts and by the governments of the three respective countries. They have thoroughly studied the chief improvements which need to be introduced into sheepfarming in such countries and have drawn up a special programme to insure their gradual realization. Again they have investigated the question of the production of fine quality wool, which is indispensable to the industry of France and have therefore planned with their agents in Australia and the Cape for an early importation of Merinos.

The report is accompanied by letters from the Minister of Commerce, the Governor General of Algeria, and the Residents general in Tunisia and at Rabat, recognizing the need for and the general interest of the Society activities. (*Union Ovine de l'Afrique du nord. Rapport du Conseil d'Amministration* 1925, p. 16, large 8vo. Paris, 1926).

485. **Great Britain: Improvement of Agricultural Land.** — The sum of £ 1,000,000 has been allocated by the Ministry of Agriculture for the purpose of aiding drainage schemes for the improvement of agricultural land. The financial facilities afforded under this programme are to be extended only to approved schemes submitted and carried out by statutorily constituted Drainage Authorities, and generally speaking, grants will be limited to an amount not exceeding one-third of the final net cost of the work. In exceptional cases, however, the Ministry has authority to provide up to one half of the cost of the work. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1, 1925).

486. **Great Britain (Barbados) : Department of Science and Agriculture.** — This new Department appears to unite under one Administrative Head the activities of the Department of Agriculture, the Island Professor of Chemistry and the Department of Agricultural Science at Harrison's College. An Advisory Board of Agriculture has been formed, consisting of one member of the Legislative Council, two members of the House of Assembly, the President of the Agricultural Society, and the Director of Agriculture. The staff is to be appointed by the Governor and will consist of a Director of Agriculture, an assistant Director and Botanist, an Entomologist, an assistant Agricultural Chemist, and a Lecturer in Natural and Agricultural Science. (*Tropical Agriculture*, Vol. III, No. 4. Trinidad, 1926).

487. **Organisation of Veterinary and Zootechnical Services in Turkey.** — The Veterinary Service forms part of the Ministry of Agriculture possessing its own autonomy. It is divided into three sections :— *Epizootic* section possessing two general inspectors ; *Scientific Establishments* (veterinary school, serotherapeutic institutes, breeding establishments) ; *Zootechnic* section with one general inspector. At the head of each section is a veterinary officer with two secretaries under him. The establishments under its supervision are : 1) the Bacteriological and Serotherapeutic institute of Dendik ; 2) the Pathological Laboratory of Erzindjian ; 3) a Central Bacteriological Laboratory ; 4) a Pathological laboratory ; 5) the Breeding station of Karadja-Bey near Brussa ; 6) the Stallion depot of Eski-cheir ; 7) the Stallion depot of SIVAS.

There are also 22 other stallion depots in the different departments and finally the schools.

Before the war there were two veterinary schools at Constantinople, one civil, the other military. Since the armistice the military school has ceased to receive direct recruits, has become a practical school of the military veterinary service and only accepts students who have previously received a diploma in the civil school.

For civil veterinary service Turkey is divided into 72 departments, for each of which there is supposed to be a director, though at the moment owing to scarcity of staff, only 60 departments are so provided. The service also comprises 95 local veterinary officials, 50 country officers, and 25 slaughter house inspectors. (*Revue Générale de Médecine Vetérinaire*, Vol. XXXV, No. 414. Paris, 1926).

Congresses and Conferences.

488. **Sixth International Conference of Ornithology, Copenhagen, 24-29 May, 1926.** — Held under the patronage of H. M. Christian of Denmark. Five sections : 1. Systematic ornithology, geographic distribution, palaeontology ; 2. Anatomy, physiology, heredity, evolution ; 3. Biology ; Ecology and migration of birds ; 4. Oology, nest building ; 5. Protection of birds and bird breeding. The International Institute of Agriculture was represented by Baron ROSENCRANTZ of the Danish Bureau of the Institute at Copenhagen.

Among the principal communications relating to agricultural provi-

sions the following may be mentioned :— Dr. GRÖBBELS, "Researches on the digestive processes of birds", "On the specific weight and the chemical composition of birds eggs", with special reference to hatching; — Dr. SCHENK, "Fat and Lean years in the world of birds"; — Dr. F. H. CHAPMAN, "The Panama island of Barre Colorado as a station for the study of tropical bird life"; — Dr. Rud. ROST, "Bird migrations in winter" — G. T. PEARSON, "Protection of birds in North America"; — Prof. SCHOENICHEN. "The present position of bird protection in Germany";

489. **International Commission on the Embellishment of Rural Life, Brussels, July, 1926.** — Subjects discussed : 1. Statement of the object of the provincial commissions for the embellishment of rural life; 2. Examination and discussion of the rules of the International Commission; 3. Embellishment of rural life in the family, the school and in social life; 4. Organization of the next International Conference.

490. **First International Cotton Congress.** — This report appears in Vol. III, No. 12, 1925 of the *Cotton Bulletin*. The Congress was held in Vienna from 4 to 6 June 1925 and was attended by 320 delegates of 21 nations. Among the more important resolutions should be mentioned the appointment of an International Court of Arbitration for the settlement of disputes in cotton circles. Arbitrators were appointed for fifteen nations.

491. **Report of the Tea Congress and Exhibition at Bandeeng Giava 21 to 26 June, 1924.** — This report has been published in an attractive form by the Experimental Tea Station at Buitenzorg ("Proefstation voor thee"). It contains the complete text of the numerous communications among which may be mentioned the reports of Dr. L. G. DEN BERGER, Dr. R. MENZEL and Mr. H. W. S. VAN HOOF of the losses caused by the Woodbubuk and other pests of the Tea plantation; of Ing. A. GROOTHOOF, of Mr. D. C. SPARNAAY and of Ing. J. H. MULLER on the use of electricity on Tea plantations; Messrs J. TANABÉ, BRAUND, MITCHELL, WILLIAMS on the tea industry and the trade; Prof. A. LENDHER, Dr. L. REMFOUS on substitutes for tea from the point of view of adulteration of the product. Drs. J. J. B. DEUSS, M. KERBOSCH, C. P. COHEN STUART and of Messrs OEIJ TIAUWHOK, C. A. BACKER and A. KEUCHENIUS on various questions of cultural theory and technic. Mr. R. du PASQUIEZ reported on the Tea plantations of Indo China. (*Handeling van het Thee-congress met tenteenstalling geheyden te Bandoeng van 21 tot 26 Juni 1924, 369 pages large 8vo, 47 diagrams*).

492. **Hawaii : Meeting of the World Educational Federation, Honolulu, 1929.**

493. **Hawaii : Third Pan-Pacific Conference on Public Instruction, Honolulu, April-May, 1927.** — In connection with this Conference two other Pan-Pacific Conferences will be held : one on public recreation including roads, parks, means of transport, resorts, hotels, amusements, protection of forests, sports etc.; the other on land reclamation including land settlement, irrigation, reafforestation, etc. These Conferences will be held under the auspices of the United States Government and the Pan-Pacific Union.

494. **Hawaii : Pan-Pacific Feminist Conference, Honolulu, July 1928.** — Four sections will be included : (1) health, specially the health of the

Mother and child; (2) the economic position of women in industry; (3) the welfare of childhood including training and instruction; (4) women in the administration.

495. **Austria: Meeting of the Lower Austrian Chamber of Agriculture, Vienna, 8-13 March 1926.** — Items on the agenda: Dr. S. SCHLINTENBAUER, the position of German Agriculture; Ing. GREIL, Agricultural fiscal Veterinary Inspector F. LENGSTEINER, herd books and functional tests; Prof. F. STAMPFT, the future of the dairy industry in Lower Austria; Ing. R. HENGL, grafting of vines; Councillor J. LÖSCHNIG, cultivation and utilization of nuts; Councillor J. LÖSCHNIG, the cultivation of cucumbers in Austria; Dr. H. LEOPOLD, silos; Ing. J. LEUTHNER, the potato and its industrial utilization; Dr. H. KASERER, the depth to which land should be cultivated; L. PORSCH, the question of sugar beet growing in lower Austria; Forestry Lieut. O. IRLWECK, economic importance of game preserving; Ing. K. POECKH, Pasturage; Dr. G. SCHLESINGER, the professional sportsman and the public; the protection of natural beauty and pasturage; Dr. V. REICH and Councillor Jax the possibility of checking the economic distruction of mountain pastures; Ing. H. LORENZ-LIBURNAU protection and export taxes; in connection with forest property in Austria; Ing. ALBRECHT, the extent to which the methods of Swiss alpine cultivation can be adapted to the conditions of Austrian alpine cultivation; Veterinary Advisor L. HOCHMULLER, serious losses to Austrian stock breeding caused by the contagious diseases of alpine cattle, and methods of controlling and preventing such losses; K. SCHMIDT, encouragement of poultry keeping on farms; Ing. K. HESS, improvement of agriculture. (*Die Landwirtschaft*, No. 4, Vienna 1925).

496. **United States: 20th Meeting of the American Society of Agricultural Engineers, Tahoo Tavern, Lake Tahoo, California, 23-26 June, 1926.** — The various sections included: the farm; electricity in agriculture; land improvement and cultivation; land clearing, and irrigation; agricultural machines; vocational organization; instruction.

497. **France: Fifth National Congress on the cultivation of medicinal plants. Nantes, 12-22 July, 1925.** — This conference was organized by the *Comité interministeriel des Plantes médicinales et des Plantes à essences* and by the *Office National des matières premières végétales pour la droguerie et la parfumerie.* These reports have been prepared for publication by Dr. G. BLAQUE, pharmacist and secretary of the Office above mentioned. In addition to the report on the strictly official side of the Congress the following papers appear in it: M. BERTOYE, Mayor of Pornichet, "Aromatic plants on the sands of the Breton coast"; Prof. P. GUERIN, "Gathering of sea weed in Brittany and utilization"; M. REVAL, "Manufacture of iodine in Brittany"; M. L. DANGUY "Utilization of the ancient salt marshes" There are besides special reports on the expeditions organized on the occasion of this Congress with the object of visiting the farm school of La Placelière and the cultivation of medicinal plants at Vannes; at Sainte Anne d'Auray et Elven (domain of Kerleau). (*Compte Rendu du cinquième Congrès national de la culture des plantes médicinales*, 17-22 July, 1925, 51 pages, 8 vo, 5 diagrams. Lons-le-Saulnier, 1926. Price 10 francs).

498. **Rhodesia: Conference on the regulation on the export of maize, Salisbury, 11 March, 1926.** — Reported in the *Rhodesia Agricultural Journal*, April 1926.

499. **Italy: First National Congress of Manufacturers of Preserved Foods. Parma, 19 April 1926.** — The Proceedings of this Congress have been published in No. 1, 1925 of the *Bollettino della R. Stazione sperimentale per l'industria delle conserve alimentari*. The Congress members approved an agenda including the following resolutions: (*a*) that the control of the production and trade in preserved foods should be made stricter and extended to preserved products intended for export; (*b*) that the Royal Experiment Station mentioned should be placed in a position to carry out its programme of work which, includes technical instruction.

500. **Tripoli: Congress of Colonial Agriculture. 15-17 April, 1926.** — The following papers formed the chief subjects of discussion: Prof. CRAVINO, The future of Agriculture in Tripolitania; — Prof. DONADONI, Tobacco growing in Tripolitania and its future; — Prof. LEONE, The forestry problem in Tripolitania; — Dr. RAVA, The Irrigation problem of Tripolitania in its relations to agriculture and land settlement; — Prof. TUCCI, The zootechnical question in Tripolitania; — Dr. DE CILLIS, Wheat growing in Tripolitania; — Dr. FANTOLI, Some meteorological factors in Tripolitania and their connection with agriculture. There was also a full discussion of the question of agricultural credit with a view to the cultivation of some of the more fertile territories of Libya.

501. **Italy: "Congresso Agricolo Pontino", Terracina, 30-31 May, 1926.** — Motions were approved relating to the reclamation of the Pontine Marshes, the technical direction of the changes in the systems of cultivation, olive growing, rice cultivation, forestry, the wheat problem of the Pontine Marshs, agricultural agreements, cattle, fisheries.

502. **Italy: Proceedings of the 1st National Italian Congress of the Milling, Baking and Sweetmeat Industries.** — Besides the official reports these acts include in their text the following communications: Prof. Dr. S. CAMILLA: The greatest, most reasonable and practical utilization of wheat by the industrial production of the flour called "Seia" (without bran, hygienic, nutritive); Ing. F. PAGLIANI: The cleansing of grain by peeling. Prof. Dr. S. CAMILLA: The necessity of instituting a Royal Experiment Station for milling, bread-baking and similar industries; Prof. Dr. S. CAMILLA: Bread-baking; Ing. S. SACERDOTE: Ovens and thermo-electric accumulation; Prof. Dr. S. CAMILLA: Industrialization in the production of bread; Ing. U. ORLANDI: The great automatic bread makers; G. VECCHIOTTI: Yeast in the bread and pastry making industry; Prof. G. ISSOGLIO: Phosphor-organic derivatives in bread-making; C. A. di GATTIHARA: Bread-making with rice flour; Prof. E. MONTI: Bread from high flour extraction and ripening processes in bread and flour. Dr. B. MARCHISIO: Mineralized nutritive bread; Dr. C. FORMENTI: Aerated bread; Dr. C. FORMENTI: The degree of humidity in badly baked bread; Ing. A. ZURASCHI: Fixed prices and breadmaking; C. MIGLIETTI: Starches and waste material in sweetmeats; Prof. Dr. P. BALDI: Colours in the sweetmeat industry; C. CIOCCA: Deterioration of sweet products during summer heat and its prevention. Ing. G. MARUCCO: Bread-making by machinery.

The volume consists of 300 pages in 8°, with illustrations. Apply to the "*Scuola per la panificazione ed industrie affini*" (Turin, Corso Stupinigi No. 11, Price L. 15 in Italy, L. 30 abroad).

503. **India : 13th Science Congress, Bombay, January 1926.** — This Congress was presided over by M. Albert HOWARD, Director of the Institute of Plant Industry at Indore and Agricultural Adviser to the states in Central India. In his address to the Congress Mr. Howard reviewed the beneficial results which have followed the practical application of botanical science to agriculture during the past quarter of a century. In India the improved types of wheat produced by the Pusa Research Institute already cover more than two million acres. The speaker mentioned the immediate beneficial results which follow the development of an irrigation system. In the case of sugar-cane it has been found that the most practical method of dealing with its fungus diseases is the production of new and resistant varieties. (*Tropical Agriculture*, v. III, No. 4, Trinidad, 1926).

504. **Uruguay : Reports of the annual Congresses of the Rural Federation.** — The "Federacion rural" of Uruguay, publishes every year reports on the Congresses that are held in different cities. This institution groups all the agricultural organizations including those of Uruguayan farm workers. From a prospectus published in the reports of the Congress of 1925 it appears that there are 47 of such organizations. The seat of the Institute is at Montevideo. For information : "*Federación Rural*", *Casa de los Rurales, Avenida* 18 *de Julio* 1919. *Montevideo.*

Exhibitions, Fairs, Competitions.

505. **Japan : Pan-Pacific Exhibition, Nagoya, Spring-Summer, 1929.**— The estimate for holding this exhibition involves an expenditure of 10,600,000 "yons" (1 "yon" gold = 2,585 fr.). The exhibition will be about twice as large as that of the "Peace Exhibition" held at Tokio in 1921. The pavilions and other buildings will cover an area of about 25 acres. The exhibition is organized under the auspices of the prefecture and the city of Nagoya, which will contribute to the cost of installation a sum of 3,000,000 "yens".

506. **France : National and International competition for motor propelled Fishing boats. La Rochelle, 14 to 19 September, 1926.** — This competition has been organized by the Under-Secretary of State for the Mercantile Marine. The fuel used by the motor-boats must be liquid, of a specific weight of more than kg. 0.810 the litre. Together with this competition and of the same kind there have been organized : an international competition for fishing-boats of small tonnage, petrol-driven ; inspection tests of fishing-boats propelled by other means, inspection tests of various apparatus for the same boats (capstans, windlasses, etc.) ; exhibition of marine motors and auxiliary apparatus of every kind.

For information apply to the Secretary for the Competition, at the *Sous-Secrétariat à la Marine Marchande*, 24, *Rue du Boccador, Paris.*

507. **International Exhibition of Horticulture. New York, 15-20 March, 1926.** — Information to be obtained from : Mr. John Young, 247 Park Avenue, New York.

508. **International Sample Fair. Havana, Cuba. 12-16 March 1926.**

509. **International Railway Exhibition, Santiago, Chile. September, 1926.** — On the occasion of the Third South American Railway Congress.

510. **XVII International Sample Exhibition. Lyons, France, 1-14 March 1926.**

511. **International Sample Fair. Salonica, Greece, 18-31 March 1926.**

512. **International Fair. Budapest, 17-26 April, 1926.**

513. **XIV International Sample Fair. Utrecht, Holland. 9-18 March 1926.**

514. **France: The Annual Colonial Exhibition of Marseilles.** — The administrative Council of the Colonial Institute of Marseilles has decided to complete the permanent Exhibition of Colonial products already installed in its Museums by starting again the special annual exhibitions that the Institute had organized from the time of its foundation, and which had been interrupted by the war and the Colonial Exhibition of Marseilles in 1922. The aim of these exhibitions will be to bring to notice a fixed number of colonial products each year from a productive, commercial and industrial point of view.

The first of this new series of exhibitions took place this years, from June 27th to July 15th, when special attention was paid to the following products: coffee, tea, sugar, vanilla and spices. By agreement with the Administrations and the Chambers of Commerce and Agriculture of Algeria, Tunisia and Morocco, the illustrative and documentary side was stressed, and it contained an important collection of photographs of great forests, geographic and economic maps, and plans of the principal works in the colonies together with all those other official and private documents that enable one to get a complete idea of the work undertaken by France in those countries. For information: *Institut Colonial, Parc Amable Canot, Marseille.*

515. **France: Manufacture of Farm tractors and petrol motors.** — The Ministry of Agriculture has suggested experiments to be held at the National Agricultural School at Crignon with the purpose of encouraging manufacturers who take part in the trials. *Bulletin de l'Office de Renseignements Agricoles*, No. 12, Paris, 1926).

516. **Morocco: Fair at Safi, 23 to 26 April.** — This fair included amongst other things: (*a*) a general competition for every sort of agricultural product from farms; (*b*) general competition of breeding stock (cattle, sheep, goats, pigs); (*c*) general competition for fat animals (cattle, sheep, pigs); (*d*) horse show; (*e*) exhibition-sale of agricultural industrial and motor car equipment; (*f*) a fisheries exhibition and implements for fishing; (*g*) farm competitions; (*h*) Congress of farmers from South Morocco.

517. **Morocco: Fair at Fez, 5-16 May, 1926.** — This fair included (*a*) the exhibition and sale of important products of Moroccan industry; (*b*) breeders' competitions; (*c*) shearing demonstrations; (*d*) auction sale of breeding stock; *e*) ploughing and cultivation competitions for mechanical and animal drawn implements, and demonstrations of the utilization of gas generating fuel in agricultural work and for the raising of water; (*g*) exhibition and sale of necessary implements generally used in agriculture; (*h*) "Mousseur" of all the tribes of Northern Morocco; (*i*) exhibition and sale of locally ma-

nufactured articles; (*l*) artistic exhibition; (*m*) horse races, et; (*n*) tourist excursions.

518. **Scotland : Grants in aid of Agricultural Shows.** — Since 1912, except for a period during the war, the Board of Agriculture for Scotland has administered a scheme for assisting agricultural shows in the crofting countries of Scotland. Assistance is given only to those shows at which there are classes confined to small farmers' stock, the term "small farmer" meaning occupiers of land of not over £100 rental or 100 acres in extent. The Board's grants take the form of a proportion of the prize money awarded, and in some cases part of the cost of the permanent equipment. With the object of encouraging small farmers to keep promising breeding animals special prizes are given in the cattle and horse classes. Keen local interest is shown by the small farmers in these shows, which have increased in number from six in 1909 to 37 in 1925. The reports of the judges indicate a steady progress from year to year in the quality of the animals exhibited whilst an improvement is also noted in the quality of the general stock of the districts apart from the competing animals. The shows subsidised in 1925 were held in Argyll, Inverness, Skye, Outer Islands, Ross, Lewis, Sutherland, Caithness, Orkney and Shetland.

Two years ago the scheme was extended to include shows confined to small landholders, occupying land of not over £50 rental or 50 acres in extent. Thus grants have been awarded to shows held in the counties of Berwick, Bute (Arran), Fife, Forfar, and Linlithgow. (*The Scottish Journal of Agriculture*, V. IX, No. 2, Edinburgh, 1926).

519. **Italy : "Cirio" competition for the chemistry or biochemistry of preserved foods. Naples.** — The Royal Academy of Physical Science and Mathematics of the Royal Society of Naples has offered a prize for competition to one or more of the best writers on any chemical or biochemical subject connected with preserved foods. The prizes amount to 5 000 lires. The competition closes 31 May 1927. Apply to the Secretary of the Academy (*R. Università di Napoli*, cortile del Salvatore).

520. **Italy : First Show of Sicilian Wheat Growing. Caltanissetta, September 1926.** — Seven sections: Collective regional exhibition; collective provincial exhibits; individual exhibits by cultivators of small, medium-sized and large holdings; educational exhibits; insecticides and fungicides; motor ploughs and animal tractor ploughs; machines and implements for the cultivation of wheat. Information: Cattedra di Agricoltura di Caltanissetta.

521. **Italy : National Fish Show. Porto S. Giorgio, Ascoli Piceno, August 1926.**

522. **Tunisia : Italian Sample Fair. Tunis, Spring 1927.**

523. **Italy : Italian Mining Exhibition, Rome, 1927.**

524. **Switzerland : Electric and Navigation Exhibition. Basel, July 1926.** — On the occasion of this exhibition a special sectional meeting was held of the World "Power" Conference for the discussion of the problems relating to power in so far as they were illustrated by the Exhibition.

525. **Uruguay : Cruising exhibition.** — A cruising exhibition is being organized to visit the principal American and European ports in order to demonstrate the progress made by Uruguay during a century of independent life.

Development of Agriculture in different countries.

526. **Brazil: Rice cultivation in the State of Santa Catharina.** — The area cultivated is about 9,300 hectares and produces about 17,000 tons of rice in the husk. The principal producing region is Blumenau, which yields 4,900 tons, then come Joinville with 2,400 tons and Ararangua with 1,950 tons. The climate of the State of Santa Catharina is very favourable to rice growing, as there are no dry seasons. The rice is planted in October and November, and is gathered in March-April.

The chief varieties grown are: — agulha, mattâo Carolina, Dourado, Japan and Honduras rice, Cattete and Cattetinho. The quantity of seed required per hectare varies from 90 kilograms if sown by hand to 40 kilograms if sown by seed drills. The harvest begins about 110 to 140 days after sowing. The yield is about 3,200 litres per hectare from irrigated lands and about 2,000 litres from dry lands. (*Brasil-Ferro-Carril*, 1925, No. 443, p. 288, Rio de Janeiro.

527. **Brazil : Rubber Growing in Para.** — The Para Rubber Growing Company (*Companhia Paraense de Plantaçâo da Borracha*) has been founded in Belem with a capital of 8,000,000 milreis for a period of 30 years with the object of developing the indigenous rubber producing forests. The Company owns 100,000 hectares of land on the left bank of the river Xingu in the municipality of Porto Moz. (*Brazil Ferro-Carril*, No. 445, p. 340, Rio de Janeiro 1926,).

528. **Brazil : Silkworm Breeding.** — The chief centre for sericulture in Brazil is the National Silk Industries Company Ltd. in the town of Campinas (State of São Paulo), which possesses every modern equipment for breeding and selection, also for spinning and weaving. The work is carried on under the expert management of Dr. P. Rosolen. Breeders in small centres are supplied with seed, and the cocoons are subsequently bought by the Company, and good prices paid. The sorts produced include primarily the Italian breeds, also Chinese, Japanese and Persian, and the period for rearing is from September to May.

The first yield from the *Institut Sericicolo* at Campinas in 1922-23 was 11,295 gm. of seed, out of which 2,408 gm. were from kinds previously found in Brazil, the remainder breeds imported from Italy. In 1923-24, 115,203 gm. of seed were produced, and in 1924-25, 248,800 gm. According to the calculations of the *Ispettorato agricolo* of São Paulo, by breeding 600 gm. of seed each time and repeating this eight times in one year, the annual yield of cocoons would be 960 kg.

Silkworm rearing is profitable in São Paulo for several reasons, the ready growth of the mulberry, the climate, the almost complete absence of disease in the mulberry or among the silkworms, and lastly the plentiful supply of labour. An additional encouragement is the certainty of sales to the Company. Mulberry plants and instructions are provided free by the Company to breeders.

The following kinds of silkworm are reared in the State of São Paulo : I. European. These spin elongated cocoons rather narrow in the middle, sometimes also nearly spherical ; the silk is of a fine yellow colour and of excellent quality. II. Chinese. These produce cocoons which are nearly spherical with silk of various colours. The two types most appreciated are gold and sil-

ver white. III. Japanese. Inferior to the Chinese as to cocoons and silk. IV. Less valuable kinds from Asia Minor yielding a whitish silk. (*Revista da Sociedade Rural Brasileira*, Year VI, No. 68, Ceres, Year II, No. 1, Sao Paulo, 1926).

529. **China : The Flood problem of Kwangtung.** — In *The Lingnaam Agricultural Review* (v. s. No. I, Canton, 1925) Mr G. W. OLIVECRONA, Engineer in Chief of the Board of Conservancy Works Kwangtung, discusses the important problem of the floods in Kwangtung. This question is certainly of great importance to the country and its solution is not easy when it is remembered that on a stretch of coast 60 miles in length, no less than four rivers flow into the sea ; viz, the West, the North, the Pearl, and East rivers, discharging, during the rainy season, about 2,000,000 cu. ft. of water per second. The Author discusses the principal means suggested as remedies against floods ; viz : afforestation, creating new outlets to the sea, storing the floods in reservoirs, cutting off bends and dredging of the river bed.

From the financial point of view the undertaking would be an immense gain to the people of the region. The cost of eliminating the danger would in round figures be $ 4.60 per *mow* (1 mow = about 0.15 Acres) of cultivated land. Considering that one rice crop represents a value of $ 25 to $ 30 per *mow*, an expenditure for necessary protection work of $ 4.60 is insignificant compared with the losses inflicted by one single flood. The scheme could be completed in fifteen years, during which time the farmers should pay 30 cents' per year per *mow* for flood protection work.

530. **Colombia : The possibility of Rubber growing.** — The regions best adapted for rubber plantations, where raw rubber can be procured in small quantities from the virgin forests, are especially the " Llanos " on the banks of the Pulumay the Caqueta, the Meta and Yapura rivers. These regions lie at a great distance from the ordinary means of communication and therefore are not easy to reach, except by the two routes formed by the Amazon and the Orinoco. A large quantity of rubber cannot therefore be expected from Colombia, the present yield being gradually on the decrease. According to the latest statistics, which are for 1923, the export of rubber amounted in that year to 310,000 kilograms with a value of 66,000 " pesos " while the statistics for 1916 showed 583 000 kilograms of rubber exported. In the period 1876-1900 the export of rubber amounted to the round figure of 1,850,000 kilograms. (*Der Tropenpflanzer* year 29. No. 4. Berlin, 1926).

531. **France : The Cultivation of Medicinal Plants in Brittany.** — In the course of the last National Congress on the cultivation of these plants, held at Nantes in July 1925, Prof. PERROT remarked that the import of these plants had fallen by 50 per cent. as compared with 1919, and that on the other hand the export had increased. This is due to the unflagging activity of the *Office National des Matières Premières* which in 1919 was set up in connection with the *Comité interministeriel des Plantes médicinales*. An intensive propaganda has been carried on by means of publications, conferences, free distribution of seeds and plants, the organisation of sub-committees, collaboration with schools, hospitals, experts, pharmacists, herbalists, horticulturists, etc., and the result has been that in the greater part of France there is no longer any necessity to import these plants.

At the present time in the region of Vannes (Morbihan), thanks to the acti-

vity of a local group, the *Flore médicinale* LA BRETONNE, fields have been sown with medicinal plant at Trussac, at the gates of Vannes (three hectares), at Sainte-Anne d'Auray (three hectares), at Ker-Hostin in the peninsula of Quiberon, and at Elven in the desmesne of Kerleau (ten hectares). A number of different kinds of plants are cultivated and a systematic study is made of them. The climate is favourable and the majority do well, including camomile, mallow, mullein, pepper mint, lavender, parsley).

The plants are dried as soon as gathered by a special hot air process which is very effective and rapid, and is installed both at Elven and Trussac.

M. BERTOYE, mayor of Pornichet, has tried experiments for acclimatizing Alpine lavender and rosemary on the so far entirely unproductive land of the dunes of Pornichet and Pen-Bron. The fields cover already 20 hectares (*La nature*, No. 2217, supplement, p. 137. Paris, 1926).

532. **Syria : Cotton growing.** — The most important fact of the 1925 season as regards cotton growing is a marked increase in the areas cultivated compared with the preceding year, the increase being noted not only in the whole area under cultivation but also in those areas planted with different varieties grown. This increase is shown in different degrees in all the States under mandate except the southern part of the State of Syria (ancient State of Damascus) in which, for reasons independent of the farmers, cotton growing is diminishing, although the growers, at the beginning of the season, influenced by the general movement had done their best to extend the areas planted.

The increase in the cotton growing area is 36.2 % compared with 1924, the figures being as follows : State of Great Lebanon 100 hectares ; State of the Alaonites 574 hectares ; State of Syria : vilayet d'Aleppo 36,507.5 hectares, region of Damascus 152.7 hectares, Sandjak of Deir 184 hectares, Sandjak of Alexandretta 1,857.6 hectares.

The produce is valued at 30,790 quintals divided thus : State of Great Lebanon 500 quintals, State of the Alaouites 925 quintals, State of Syria : vilayet of Aleppo 27 500 quintals, region of Damascus 305 quintals, Sandjak of Deir 25 quintals, Sandjak of Alexandretta 1530 quintals.

In spite of the fact of this increase there is still an absence of any definite direction such as would assist the growers to utilize to the full the natural resources of the country, with due attention to the particular requirements of the different varieties of cotton grown, and so get more profit from their efforts. It may be objected that cotton growing is still of too recent a date, and has been developed in districts too different in character for a uniform method of growing to be enjoined. At the same time it seems hardly wise, in view of the attachment to traditional methods of Syrian cultivators, to leave them free to use methods which might be contrary to their own interests as well as to the general interest of the country. Accordingly it seems preferable to teach them principles, the application of which would bring the most advantage, consistent with modifications which may emerge in practice. The working out of these principles is now quite practicable, since, as a result of the work accomplished in the last five years both by the Government Experiment Stations and by experiments privately made on plantations of varying size and under varying conditions, considerable data have become available for the agricultural services of the regions and from these much information of value for cotton growing

may be drawn. (From a report dated February 8, 1926 sent from Damascus to the International Institute of Agriculture).

533. **Andaman Islands : Forestry.** — In these islands there are about 2.200 sq. miles of virgin forests and it is calculated that two-thirds of these might be profitably worked. The quantity of timber that could actually be marketed is calculated to be about 10 tons per acre, a total of 8.960,000 tons, whilst the annual yield sustained would be about 100,000 tons. The formation of the country is extremely favourable to the cutting and shipping of timber. The Forest Department now employs about 1000 workmen in its two divisions in the North and South Andamans. During the last five years the average volume of timber exported has been only 6 000 tons per year, although last year it rose to 8,500 tons of which 1,850 tons were sent to Europe. The existing plant is capable of an output of 22,000 tons a year, but according to the *Gazette of India* even when this figure is reached there is still scope for a much larger development, in these islands given favourable market conditions. (*The India Forester*, V. LII, No. 6, Dehra Dun, U. P., India 1926).

534. **Algeria : Colonization during the ninety years 1830-1920.** — The first attempt at true colonization dates from a decree of Marechal Bugeaud in 1841, for all efforts made before had been frustrated by local insurrection. The regulations made by BUGEAUD were too military in character and colonization became a very heavy undertaking for the holders of the land, until a decree of April 26th, 1851 lightened the burden of the colonists and gave them under certain conditions the immediate property of the land.

Between 1841 and 1851 the Administration created about 126 towns and villages and made grants of land amounting to a total of 115,000 hectares (15,000 grants). Between 1851 and 1860 other 85 centres were formed and 250,000 hectares of land granted. After 1860 these grants or concessions were sold by auction, and financial companies obtained areas from 20,000 to 100,000 hectares. Between 1861 and 1870 21 centres were formed and 116,000 hectares of ground sold (chiefly to natives) : in the next ten years 400,000 hectares were granted and from 1880 to 1900 other 296,000 hectares were granted free (creating about 210 centres) on the condition of residence on the land for at least five years. From 1900 to 1921 the Governor General, can on the advice of the Government Council sell by agreement, by public auction, at a fixed price, or grant free, according to the interests of colonization. The grantee must personally cultivate and reside on his lot for 10 years, conform to the clauses and pay the price of the ground as fixed. Under certain circumstances he may transfer his obligations to a family. From 1901 to 1920 199 villages were founded and enlarged and 200,000 hectares granted, (L. R. La colonisation en Algérie de 1830 à 1921 : *Revue Scientifique*, y. 64, No. 1, 1926).

535. **Italy : The cultivation of Aromatic and Medicinal plants.** — " L'Istituto di Fondi rustici " at Rome has promised to form a Society to which it will belong and for which it will provide the greater part of the capital, which will be for the promotion of the growing of aromatic and medicinal plants in Italy. The Society has its headquarters at Florence and its direction is in the hands of an expert already noted for his activity in this matter. In the large business concerns that the Society possesses in various parts of Italy and its islands, the cultivation of easily grown aromatic and medicinal

plants will be started. In addition the society will look after the national harvesting of plants that grow wild in the different regions and organize the trade in them, both in Italy and abroad. Already centres have been prepared and the cultivation of many different kinds has been started : mint, lavender, staphisagria, hyssop, flea-bane, aniseed, soya, borage, camomile, cnicus benedictus, sage, pellitory, etc. (*Giornale di Agricoltura della Domenica*, Year XXXVI, No. 19. Piacenza, 1926).

536. **Peru : Measures for development of Agriculture.** — The irrigation work is progressing rapidly and definite plans are being elaborated. That of the *Pampas de Olmos* and the *Pampas Imperial* are of tremendous benefit to agriculture in those regions. Another special form of irrigation has been planned by organizing groups of persons of small means who give their labour and a small sum of money towards the necessary works. Experiment stations have been established at Cajamarca, Jauja, Acobamba and Moquegua, to improve the cultivation of wheat, and experiments have also been made in growing forage plants. In order to protect the crops in the lowlands from plant diseases regulations have been adopted dealing with the importation of sugar-cane seed and the obligatory fumigation of Tanguis cotton-seed. (*Bulletin of the Pan American Union*, Jan. 1926).

Miscellaneous.

537. **Argentine : The cotton trade of Argentine.** — The cotton commerce division (Division Comercial Algodonera) of the Ministry of Agriculture has published a propaganda book with the purpose of promoting the co-opetive sale of cotton. In the publication nothing of use is forgotten, starting from the principle that a rapid increase in the Argentine cotton produce depends chiefly on the institution of efficient business methods for dealing with this product. The most expert cotton merchants of the world show by their example that the method of co-operative negotiation practised in Denmark for all agricultural products, and partially in the United States, is also the best system to be adopted for cotton. The publication also described a scheme of co-opearative cotton negotiation adapted to the existing conditions of the Republic, and contemplates the creation of a co-operative " *Federacion Nacional* " for its sale. This will of course be formed from the different local agricultural associations to be found in all the cotton zones, and directed by the same cotton producers. The publication gives minute details and clearly describes the methods to be followed in order to institute the above named federation, and gives also an explanation of several adequate models. (Ernest L. TOTT. Negociación cooperativa cotoniera. *Ministerio de Agricoltura, Seccion Propaganda e Informes*, pp. 118 in 16° Buenos Aires, 1926).

538. **Brazil : Fruit Trade in Brazil.** — In 1924 Brazil exported 866 tons of pine apple (abacacis) ; 3,879,428 bunches of bananas ; 2,010 hundreds of cocoa nuts ; 750,685 hundreds of oranges, nearly all destined for the Argentine, and the value of which amounted to 15,500 contos. Brazil imports annually 2 600 contos of grapes; 2,000 contos of pears ; 3,000 contos of apples, the greater part of which come from the United States. (*Brazil Ferro Carril*, Year 1926, No. 444, p. 311. Rio de Janeiro).

539. **Brazil : The propaganda for the sale of Brazilian Coffee.** — For this purpose there exists in San Paulo "*L'Instituto del Caffé*" which has also an agency in Santos and a financial section which is occupied with demands for loans on the security of the stock of coffee deposited in the warehouses (armazens regulatores).

The Institute has a statistical and propaganda section, which permits it at any moment to estimate the situation of the product throughout the world. A short time ago an agreement was concluded with the State of Minas, others are proposed with the States of Rio de Janeiro and Espirito. Meanwhile it is aiming at a greater sale of coffee throughout the world, making use of extensive propaganda and granting bonuses to tradesmen who increase the sale of this article. (*Brazil Ferro-Carril*, 1926, No. 445, p. 320, Rio de Janeiro).

540. **United States : History of Agriculture in the Northern United States.** — Part of a series of publications on the economical history of America, published by the sociological and economical section of the "Carnegie Institution" of Washington. It describes the vicissitudes of agriculture at the time of the first colonists, rural economy in the XVIII century, the period of expansion and progress from 1800 to 1840 and the period of transformation from 1840-1860. It contains besides a critical bibliography, an index of authors, and a statistical appendix. (P. W. BIDWELL and J. I. FALCONER. *History of agriculture in the Northern United States*, 1620-1860; XII, 512 pp., 6 tab. 106 fig. *Carnegie Inst. Wash.* Pub. 358; 1925).

541. **United States: An Excellent American herbarium** has been given by Mr, E. D. Riley of Absecon, N. J. to the department of botany of Rutgers University. This collection contains ten thousand dried plants, valuable material from the southern part of New Jersey and a considerable number of plants from Ohio and California. A part of the collection was exhibited by Mr. Riley at the Colombian Exhibition. (*Science*, V. LXIII, No. 1636. Washington, 1926).

542. **China : Agriculture in China.** — Dr. Wilhelm Wagner has edited what may be called the first complete work on this subject. In about 700 pages in 8°, he reviews the Chinese agricultural zootechnical conditions based on an accurate study of the historical geographical and social conditions of the country. Dr. WAGNER who has been a teacher of agriculture and head of a section in the German High School of Agriculture at Tsingtau (China) develops the different arguments in a most rigorously scientific manner. The chapter on Chinese horticulture and fruit growing is by Dr. BERTRAM KRUG who was also a teacher in the above named school, and in the chapter on zootechnics the section on mule and camel breeding is from the pen of Dr. HANS BUCHMANN-GÖRLITZ who lived for a long time in China and Mongolia.

The volume is richly illustrated and divided into three parts: (1) Natural factors and their influence on agricultural production in China, (2) Economical conditions of China and their influence on agricultural production, (3) Chinese Agriculture in its technical organization and its consequences on private economy. An excellent bibliography closes the volume. (W. WAGNER, *Die Chinesische Landwirtschaft*, 683 pp. Lexicon format, 204 illustrations, 2 maps. Berlin, *Verlag Paul Parey*, 1926. Price, 42 R. M.).

543. **China : The production of Commercial Eggs.** — In this Republic there are actually 31 establishments occupied with the production of eggs and

amongst them five of the most important are situated at Shanghai and worked by strangers. They trade in preserved eggs. "The Chinese Egg Producing Company, Shanghai" is the one that does the most business. (*The Lignam Agricultural Review*, V. 3, No. 1. Canton, 1925).

544. **The United States : The navigation of the Missouri.** — The War Office has announced the assignment of two million dollars for work to be done in facilitating the navigation of the River Missouri, and has at the same time given the assurance that the sum will even be increased should the work be done with such rapidity as to urgently require additional funds. In this way, by the development and improvement of inland navigation, a great progressive movement will be realized for the regions drained by the Missouri, which will satisfy many of the agricultural needs of these same regions. (*The Agricultural Review*, V. XIX, No. 5. Kansas City, Missouri, 1925).

545. **The discovery of Vitamins.** — Casimir FUNK in an article published in *Science* (v. LXIII, No. 1635, 1926), criticises the views expressed by many research workers who attribute the discovery of vitamins to Sir Frederick G. HOPKINS. He concludes by saying that this discovery should be considered as the result of collective work of many investigators who besides Hopkins, include Bunge, Rohmann, Stepp, Eykmann, Schaumann, Suzuki (as well as Funk himself). As regards Hopkins, the important services rendered by him in the field of Biochemistry, Physiology including the discovery of tryptophane, Chemistry of the muscles etc., have placed him in the first rank as one of the most eminent exponents of Biochemistry.

546. **The book of Rural Life.** — This book is an agricultural encyclopedia and can be considered as a complete and characteristic account of North American rural life. The work consists of ten large volumes, and every phase of agriculture is exposed and treated in a simple and direct manner, as are also many other subjects relating to rural life. The book contains all that can possibly interest a farmer in the management of his farm. The ten volumes include altogether 8,500 original signed articles, with a total of 6,200 pages and 6,000 illustrations of animals, plants, and country scenes, besides 100 coloured plates. The authors of the various articles are 250, the signatures are those of experts in agriculture and of a few collaborators from among those authorities so numerous in America who interest themselves in agricultural and allied questions. At the end of the last volume is a general classification of the questions treated which is subdivided into the following sections: (1) Agriculture; (2) Domestic economy; (3) Hygiene; (4) Education and culture; (5) Science; (6) Civil and commercial information.

A detailed index and, above all, notes on the special characteristics in the different articles ensures the quick discovery of the information required, and avoids repetition. Besides this the Publishing Firm proposes to keep the reader informed of the latest agricultural news by the publication of a yearly volume. The idea of such a book originated with John Bellow (of the Publishing Firm of Bellows-Durham Company of Chicago), who himself the son of a farmer, has left no means untried (at least he has spent on it more than 250 thousand dollars) to make his idea materialize. In short the print is excellent, the volumes bound in leather, the paper is very good, and the illustrations, are clear and neat. (*The book of Rural Life; knowledge and inspiration a guide*

to the best in modern living, 10 vol., 6200 pages, 6000 fig. and over 100 tables. Edit. Bellows-Reeve Company, 104 South Michigan Ave, Chicago Ill. (U. S. A.) 1925. Price (excluding U. S. and Canada) 79.50 dollars, duty and postage not included.

547. **Cuba : The Curtailment of Sugar-Cane cultivation.** — The Cuban government is studying measures to be issued with the aim of avoiding an excessive production of sugar. Such measures it seems would be favourably received by the proprietors of the sugar-cane plantations. (*The Agricultural Review*, V. XIX, No. 5, Kansas city, Missouri, 1926).

548. **The Herbarium of Auguste de Lugo.** — Mlle. DESAZARS DE MONTGAILLARD has left to the Laboratory of vegetable Biology of Fontainebleau the herbarium of her uncle Auguste de Lugo. This precious collection contains the dried plants of France, Spain, Algeria, the Canaries, and also the dried mosses of Husnot and lichens of Schaerez. The most interesting point is that it contains all the plants of the Pyrenees which having been gathered between 1820 and 1880 form a truly unique collection of its kind.

549. **Disappearance of the bread fruit tree.** — This tree (*Artocarpus incisa*) is beginning to disappear from the Pacific islands (Society Marquesas, and Fiji) in much the same way that the natives are also gradually disappearing. It is noted that the Marquesas islands at one time possessed whole valleys densely populated with these trees, valleys that are now being transformed into jungles. Dr. J. J. Webster of the Philippine islands learning that the bread fruit tree can be grown from pieces of the root, is making attempts at transplanting at Lamas in order to preserve this valuable tree. (*Nature*, No. 2722. Paris, 1926).

550. **Canada : The lading of cereals in the port of Montreal.** — During the last twenty years Canada, as is well known, has become the largest cereal producer in the whole world ; and the export of these products has risen from 35 million hectolitres in 1902 to 75 million in 1922. Therefore the problem of Canadian Cereal exports consists in being able to despatch the maximum quantity before the winter, that is before the ice blocks the ports. The Canadian ports and especially Montreal have therefore been specially prepared so as to be able to satisfy the exigencies of this immense traffic. Montreal lies about 1,600 kilometres inland and is connected with the sea by a canal that has a minimum depth of ten metres at low tide. The port possesses about 14 km. of wharfs. About a third of the export trade of Canada passes through this port and represents a value of about 700 million dollars a year. Four enormous elevators for cereals have been installed. One of them, the most important in the world, has the power of discharging 14,000 hectolitres an hour or 36 wagons. At the same time it can load a ship at the rate of 25,000 hectolitres an hour. The silos that it serves have a total capacity of 1,400,000 hectolitres. No. 2 elevator serves silos of a total capacity of 900,000 hectolitres and possesses a transporter system that serves in turn 20 berths and has a total capacity of 52,000 hectolitres per hour, and can also load two ships at the same time at an average of 12,000 hectolitres an hour. Besides this there are four metal towers on rails with elevators that have been provided for the discharging of ships coming from the Great Lakes. (*Génie Civil*, July 1925).

551. **New Zealand : Tree-Planter's Guide.** — The New Zealand State Forest Service has published a small volume containing practical instruc-

tion and information for sylviculturists. Directions are given in clear language and the publication is in every way an example of highly attractive propaganda for the preservation of the existing forests and for re-afforestation. The nursery plantations at Rotorua (North Island) and at Haner Springs (Canterbury), Tapanui (Otago) and Naseby (Central Otago) supply trees at moderate prices for the plantations. The guide has been re-edited, under the direction of Sir R. R. HEATON RHODES, Commissioner of State Forests and on the basis of experience gained in New Zealand during twenty five years of practical sylviculture. (*Tree-Planter's Guide*, 16 pp. Wellington, 1924).

552. **South Africa: History of Agriculture.** — In a manual entitled "Selected Subjects in the Economic History of South Africa", (Cape Town 1924) certain chapters are given by Mr. H. de Kock on agricultural progress and pastoral resources under the administration of the Dutch East Indian Company (1652-1795) as also on the agricultural conditions of the region from the beginning of the British occupation.

553. **Greece : The adoption of the Metric System.** — This system of measures came into force by law from 1 March 1926. Previously the kilogram had been adopted in the Greek Customs tariff as the legal measure of weight. In practice however the *oka* of 1.282 kilogrammes and the *oka* of about 1.30 litres continue in use. The metric measures of weight and capacity will not become obligatory till 1 March 1927, and in the meantime the Government has to institute at Athens an Office of Inspection for weights and measures.

554. **Italy : Application of Legislation with regard to Land Reclamation.** — A practical guide to legislation on land reclamation has been produced by Dr. ELISEO JANDOLO, Inspector at the Ministry of Public Works, in the form of a substantial article of some thirty pages, octavo, published in the *Annali dei Lavori Pubblici* Year LXIV, No. 2, 1926. This of course, refers to the law of 30 December, 1923, which cancels in the matter of transformation of swamps and marshland all such provisions as may previously have been in force but are not embodied in the new text.

The article contains a general survey of the provisions for land reclamation, as undertaken by the State or by the persons concerned, and for this purpose the schemes for land improvement are grouped under two categories.

Some general observations follow as to framing the statutes of the recently formed land improvement companies and as regards new schemes to be taken up by provincial or communal associations previously existing. There is next a practical demonstration of the conditions which determine in the various cases the concession of land reclamation schemes of the first category ; the technical and financial stipulations for any such concession ; the extent to which contributions will be required from the State, the provinces and the land owners respectively ; the assessment and collection of these contributions ; the guarantee for payment of them ; credit facilities ; financing of the work involved ; upkeep of works when constructed ; the processes by which the land is improved and transformed after drainage ; minor schemes of land improvement (in the second category) ; and the part taken in the work (as regards the Pontine Marshes) by the municipalities of Anzio and San Felice.

555. **Italy : Irrigation Services.** — The Hydrographical Service of the Ministry of Public Works has extended its activities to the utilization of water

for agricultural purposes with special reference to irrigation schemes, and has recently published a special study of the subject: *Le irrigazioni in Italia: notizie preliminari sulla estensione delle irrigazioni, sulle modalità di esse e sui prezzi praticati nelle diverse regioni italiane* (Roma, Libreria dello Stato, 1926), containing the results of investigations undertaken with a view to obtaining accurate knowledge of the conditions which at the present time determine the irrigation problem in Italy. The enquiry took account of the following factors: (*a*) quantity of water at present supplied per hectare in the various regions and in respect of the various crops; (*b*) practical methods employed in irrigation, (length of time, systems of rotation, etc.); (*c*) units of measure applicable and charges to be made for water; (*d*) estimate of water requirements for various crops; (*e*) brief note with regard to the extent of the irrigated zones in the various districts of Italy.

The following reports are of special interest: — the report on the valley of the Po by Prof. GIANDOTTI and that by Eng. PALLUCCHINI on the region of the Veneto. These communications are prefaced by introductory considerations of a general character: Prof. E. EREDIA supplies a chart of the high-temperature conditions obtaining in the regions of Italy during the period when irrigation is practised (April-September), Eng. G. DI RICCO gives some statistics as to measurements of rainfall, and Prof. G. DE MARCHI goes on to examine the principal results which the reports of the Sections establish in relation to the water supply conditions of the various divisions.

The point which is specially brought out is that the quantity of water supplied for agricultural purposes depends exclusively on the amount of water available and not on the actual requirements, there being frequently a wastage where water is in abundance and a shortage where it is difficult to provide an adequate water supply. Local habits and traditions have more weight than rational considerations in determining the ways and means of irrigation. The prices at which water is sold are apt to vary very much even in coterminous districts, at times they may be so high as to make it an economic proposition only to irrigate crops of a very high yield and at times prices are very low in relation to the various sources from which the water is tapped.

The data derived from observation of local practice with regard to the quantity of water actually necessary for various forms of cultivation are scarcely ever reliable since there is on all sides a tendency to consider as indispensable whatever water is available. Finally the examination of rainfall measurements establishes a fact which is perhaps contrary to the general belief, namely, that the differences between the amounts of rainfall during the irrigation period, and in the various districts are slight in comparison with the supply of water required for irrigation purposes. The volume provides also a number of illustrations and three charts of rainfall measurements for the different periods of the summer season.

556. **New Views on the Physiology of the Flower.** — Certain new views are being put forward on the importance of the floral envelopes in relation to their function which will undoubtedly modify the old view of SPRENGEL that the perianth acts as a kind of banner (vexilla) for purposes of attraction. Prof. GUSTAVO BRUNELLI, in a brief note remarks that there ought to be much wider circulation of certain studies such as those of BUSCALIONI and POLLACCI

on the anthocyanins especially from the point of view of the oxidases, since the principal function of the floral envelopes may be respiratory. According to the phylogenetic point of view this "*vexillary*" function would be grafted at a later time on to the respiratory functions of the flower, which would render more comprehensible the evolution of this organ, but it may be necessary to discard the theory of SPRENGEL as to the relations between forms, colours and scents of flowers and the animal world, in particular insects. (GUSTAVO BRUNELLI, *Funzione respiratoria e funzione vessillare del fiore*, 12 pp. small 8vo. Roma, 1925).

557. **Paraguay: Classification of Cotton.** — The Government has issued appropriate ordinances which are now embodied in a law providing for the creation of a State Department for cotton classification and in a decree fixing the grades of cotton in bale ready for exportation. Five categories are distinguished: I. Special; II. Good First Quality; III. First Quality; IV. Second Quality; V. Inferior Second Quality. The formalities of State inspection are duly prescribed, and it is provided that such inspection may be carried out, if so desired, in private concerns. The technical bases of the process of classification are also established. (*Diario Oficial*, No. 1155, 1163: 1925).

558. **Dutch Indies.** — The Commercial Section of the Department of Agriculture, Industry and Trade of the Dutch Indies has published a booklet in French carefully compiled and well illustrated with photographs, giving a concise but fairly complete account of the Dutch Indies, particularly in respect of agricultural and economic resources. Emphasis is laid on the importance of those islands in international economic relations, as supplying tropical products on a large scale and having extensive direct trade relations with a number of consuming countries, chiefly European. This issue of the manual is especially intended for circulation in France, Belgium and Switzerland, and the Commercial Section contemplates a subsequent publication of a more complete work with special reference to the economic aspect of questions affecting the Dutch Indies. (*Les Indes Néerlandaises*, pages 74, 16mo large, 26 photographs. No date).

559. **Dutch Indies: Centenary Publication on Cultivation of Tea (1824-1924).** — The Experimental Tea Station (*Proefstation voor Thee*) at Buitenzorg (Saxa) has produced a substantial series of articles profusely illustrated in a volume published on the occasion of the Tea Congress held at Bandoeng in 1925. The book contains an explanation of the various difficulties with which the cultivation of the product in question has had to contend during the period of a hundred years (1824-1924) and a survey of its development. It opens with three historical studies, Dr. C. H. BERNARD (Director of the General Experimental Tea Station) writes on the "Progress of the Cultivation of Tea in the Dutch Indies", — Dr. C. P. COEN STUART (a Plantation expert at the Experiment Station) on the early days of Tea cultivation in Java; — H. C. H. DE BIE (Inspector of Agriculture) has a study on Dutch Tea Cultivation from 1830 1924, Other articles include a study by T. J. LEKKERKERKER (Inspector of Agri cultural Instruction) on two regional associations of tea planters, a contribution from a "Master Storekeeper" on the fluctuations of Java tea on the Dutch market, and one by D. LAGEMAN on the functions of the Tea Expert. — Dr. COHEN STUART in an article "Assam Versus China" deals with tea cul

tivation from the stand point of agricultural economics, while Dr. BERNARD presents the results of study and observation on the tea blight (*Helopeltis*), and Dr. J. J. B. DEUSS (Chemist at the General Experiment Station) comments on the conclusions of JACOBSON with regard to cultivation of the plant and on the development of the technical processes by which the product is prepared.

There are in addition some reminiscences by MM. W. P. BAKHOVEN, L. A. F. H. Baron Van HEECKEREN tot WALIEN, Dr. C. P. COHEN STUART, of the original conditions both of planters and plantations which led to the development of the tea wealth of the Dutch Indies, as also in conclusion a history of the Agricultural Association of *Soekabomi* by W. DE WOS and a history of the Experimental Tea Station by Dr. Ch. BERNARD.

The volume is completed by a very full bibliography and illustrated by some striking plates, several coloured. (*Gedenkboek der Nederlandsch Indische Thelcultur* 1824-1924. *Uitgegeven door het Proefstation voor Thee big Gelegenheit van het The congres met Tentoonstelling*, Bandoeng 1924, pages 242, 8vo, 42 plates *Weltevreden* no date).

560. **International Wine Trade from 1900-1925.** — At the Jubilee Congress of the " Comité international pour le commerce des vins, cidres, spiritueux et liqueurs in Paris " the " Fédération Suisse des négociants en vins " presented an extensive report on this subject with a wealth of statistical data and appropriate comment. The report dealt with the question under various headings-wine production, legislation in respect of traffic in wines in the various countries both as regards producers and consumers, the home marketing and consumption, import and export data, customs tariffs and excise duties levied on wine, teetotalism and its influence on the international traffic in wines, the organization of wine production and trade.

The conclusions of the report may be summed up as follows : (*a*) a better legal definition of the so-called *non-alcoholic* wines, prohibition of use of this or any similar description arising from the inclusion by different legislations under the definition " wine " of non-fermented grape-juice and the fermented products of quite different fruits ; (*b*) prohibition of the manufacture and sale of artificial wines ; (*c*) reduction of fiscal burdens on the wine trade ; (*d*) organisation against the Prohibition League ; (*e*) general propaganda throughout the world in favour of wine.

Journals and Reviews.

561. **Germany : Cheesemakers' Pocket book, 1926.** — Published by P. PAREY of Berlin, the 49th year of this well known German hand-book sees its appearance in two parts. The first part, in addition to the customary general calendar and diary, contains a handy technical summary of everything relating to the management of cows in milk and to the processes of cheesemaking. The tables have been compiled from recent statistics of the industry. The second part contains a complete list of addresses of cheese making and similar establishments in Germany, the information relating to over 10,000 firms, and a systematic survey of all those public institutions, which in the German Republic are promoting the science and industry of cheesemaking. In addition there will be found inserted the legislative and administrative provisions on

the subject. (*Milchwirtschaftliches Taschenbuch für 1926*. Year XLIX. Berlin, 1926).

562. **China: A New Agricultural Journal.** — Under the litle of " Lung Pao " a new journal has been published at Foochow, in Fukien, by the Union of Foochow Agricultural Associations. It contains articles in Chinese.

563. **United States: Some Changes in the Experiment Station Record.** — With the beginning of a new volume of this old-standing and valuable review, published by the *Office of Experiment Stations* of the U. S. Department of Agriculture, a number of changes have been made in the arrangement of part of the material handled, so as to make it more convenient and readily accessible to readers. While the Section on "Foods - Human Nutrition" will be continued and will include as before the fundamental studies which have always been associated with human nutrition, there will now follow immediately on it two new sections dealing with questions closely connected with home economics, one entitled " Textiles and Clothing ", and the other " Home Management and Equipment ". The first of these sections embraces studies of the handling and utilization of textile fibres and similar materials which were previously put haphazard among the articles on agriculture, forestry or farm production, as well as studies of clothing and laundering, for which no appropriate place has previously existed. Under Home Management and Equipment are included many of the farm home studies formerly classified under Rural Sociology and Agricultural Engineering.

The additional sections are obviously considerably broader in scope than the portions which they replace, and it is hoped ultimately to develop them with the growth of their respective subjects. Unfortunately, however, the total space available in the *Record* is now no greater than before. The last enlargement from 1600 to 1800 pages per annum was made in 1911, since which time the quantity of agricultural research has immensely increased, involving severe pressure on the space for abstracts. Only comparatively little expansion can therefore be expected on any subject, but it is hoped to cover as adequately as possible the studies made by the Department of Agriculture and the Experiment Stations. (*Experiment Station Record*, Vol. 54, No. 1. Washington, 1926).

564. **Italy: Special Number on Mulberry Growing and Silkworm Rearing.** — The fourth number of the current year of *L'Italia Agricola* is devoted entirely to the subject of mulberry growing and silkworm rearing in Italy, the articles being profusely illustrated. Among the contributors are V. ALPE: Changes in type of mulberries and silkworms in Italy; — G. DRAGONI: General Survey of the world production and trade in silk; — L. ARIMATTEI: The silk industry and trade in Italy; — E. MALENOTTI: The great benefits of the mulberry rearing of silkworms; — E. PARENTI: Ancient and modern mulberry cultivation; — C. ACQUA: The technique of the production of the silkworm; — R. GRANDORI: Problems of the Italian silkworm seed industry; — L. CASTELLI: Failures in silkworm rearing in Italy; — V. FIORUZZI; Silk worm rearing on a permanent industrial scale; — M. BATTAGLIA: Mulberry growing and silkworm rearing in Japan. In addition to letterpress, this number contains a table showing production of cocoons in the different provinces of Italy.

565. **Italy : Official Bulletin of the Royal Experiment station for the Industry in Essences and other products of Citrus Fruits, Reggio Calabria.** " *Bollettino Ufficiale della R. Stazione Sperimentale per l'industria delle essenze e dei derivati dagli Agrumi in Reggio Calabria* „ — This is the title of a monthly review which has begun to appear in Reggio Calabria as from 1 January of this year. Besides original contributions, the Bulletin contains abstracts and economic and trade particulars. In the first two numbers there is a short account of the work of the Station done to encourage the preparation of citrus fruits essences, etc. The Bulletin is the continuation of the " Annali " of the Station of which two volumes had already appeared.

566. **Italy : " L'Industria italiana delle Conserve alimentari ".** — This is the title of the bulletin of the Royal Experiment Station which has been organised for the food preserving industry at Parma. It appears monthly, beginning with the January issue of this year. Annual subscription : Italy, Liras 20, other countries Liras 30. Offices, *Parma, Viale Faustino Tanara*, 21.

567. **Italy : Bulletin of the Royal Plant Pathology Station at Rome.** — A new series of the *Bollettino della R. Stazione di Patologia Vegetale* began in January of this year, showing the greater impulse which the directors of the Station, Prof. L. PETRI and B. PEYRONEL, are intending to impart to enquiries and investigations into phytopathological questions connected with Italian agriculture especially that of Southern Italy.

568. **Italy : " Il Notiziario chimico industriale ".** — This is a new review which is published monthly at Turin and is edited by a committee composed of persons directing the most important institutions of applied chemistry in Turin. Among those are Prof. BALDRACCO (R. National Institute for the Leather Industry) ; Prof. F. GARELLI (Institute of Industrial Chemistry at the Royal School of Engineering) ; Prof. L. MASCARELLI (Institute of Pharmaceutical Chemistry of the University) ; Prof. C. MONTMARTINI (Institute of General Chemistry at the Royal School of Engineering) ; Prof. V. SCURTI (Royal Agricultural Station) ; Dr. V. PREYER (" Fiat " Research and Inspection Laboratory) ; F. GROTTANELLI (Nobel Dynamite Company Ltd.). Annual Subscription : Italy, Liras 80 ; abroad, Liras 140. Business Office, Via Ospedale 20, Turin.

569. **Japan : Bulletin of the Chemical Society of Japan.** — The issue of this Bulletin began in January of the current year. Reports are published in their original form, English, French or German, and the Bulletin contains contributions sent to the Society, as well as original articles in Japanese. Chief Editor Jitsusaburo SAMESHIMA (Chemical Institute, Faculty of Science at the Tokio Imperial University). Annual subscription for 12 numbers : 4,00 Yen.

570. **Latvia : Acta Horti Botanici Universitatis Latviensis.** — This publication, otherwise known as *Latvias Universitates Botaniskà Dârza Raksti*, will appear three times a year. Editor : Dr. N. MALTA : *Riga, Kronvalda bulv.* 4, *L. U. botaniskà laboratoria*. The articles are published in German, English and Latvian.

571. **Czecho-slovakia : Annals of the Agricultural Academy.** — Under the title of Sbornik českosloveuské Akademie Zemědělské this is a new review of the progress of the agricultural sciences. The publication is divided

into two parts : Part A containing original contributions ; Part B abstracts and bibliography. Among the contributors are names of repute in agricultural science, STOKLASA, ERNKA, SMOLIK KOPECKY, KREJCI, CHEMLAI KRIZENECKY, REICH. The first number contains original articles by STOKLASA and BARES on the mechanical processes of the anaerobic respiration of the plant organs ; LASCA on cheese bacteria; NOVAK on the climatic and pedological types of Czecho-slovakia ; TAUFER on registration and records of the data of performances and heredity among the dairy cattle of Moravia ; KAS on investigations of the physics of soil science.

The annals are published in Prague. Price 24 Kc. (Apply, *Secretariat de l'Académie, Prague II, Jungmannova,* 18).

Personal.

572. Dr. J. C. ARTHUR, emeritus professor of " Perdue University ", has been appointed an honorary member of the Russian Botanical Society in the mycology Section, in recognition of his researches on mildews.

573. In the Portuguese Review " Brotoria " No. 1,1926, published at Caminha, an obituary notice appears on the Rev. JOAQUIN M. A. DE BARNOLA by the Jesuit father JAIME PUJIULA. director of the Biological Laboratory of Sarria. Father de BARNOLA who died in June 1925 has left works of an educational character on botany and mineralogy. The results of the important expeditions organized by the *Institución Catalana d'Historia Natural* of which he was president and by the *Sociedad Iberica Seccion de Barcelona,* of which he was permanent secretary, have been embodied in a number of valuable scientific notes and in the report entitled " Flora vascular del Principado de Andorra ".

574. The death is announcd of Prof. W. BATESON, director of the " John Innes Horticultural Institution " Merton, England. As is well known, Prof. Bateson was renowned as an exponent of Mendelism, and his works on genetics, particularly " Mendel's Principles of Heredity " occupy, a conspicuous place in the extensive contemporary literature on heredity and selection.

575. Prof. ANTONIO BERLESE, a well known worker in the sphere of agricultural entomology and of phytopathology, has been presented with a gold medal and honorary diploma by the Agricultural Society of Lombardy.

576. The wellknown horticulturist LUTHER BURBANK died on April 11th last at Santa Rosa, California, at the age of 77 years.

577. Sir THOMAS H. ELLIOTT, permanent Delegate of Great Britain at the International Institute of Agriculture, and Councillor of the British Embassy to the King of Italy, died in Rome last June. Sir Thomas was an expert in all branches of agricultural administration and for over twenty years was Secretary to the Ministry of Agriculture and Fisheries in London. His work in connection with the control of foot and mouth disease and other contagious diseases of stock was particularly effective, and his name will always be associated with the marked development of his Department which took place during the earlier years of the present century. His interest in the International Institute of Agriculture dated from the days of its foundation, and latterly

he was one of the most active and devoted members of the Permanent Committee.

578. Prof. ALOIS GROSS, director since 1904 of the *Landes-Ackerbau-und Flachsbereitungs-schule* of Schönberg, Moravia, and member of the Government Adjudicatory Commission for agricultural instruction, on which he did most valuable work, died on 15 March.

579. Prof. EDUARD HACKEL, the eminent Austrian professor of Agronomy, died at the age of 76. His works on plant classification are renowned. His fine herbarium was acquired several years ago by the Viennese Museum of Natural History.

580. Prof. S. C. HARLAND has been appointed Head of the Department of Genetics on the staff of the Cotton Research Station of the Empire Cotton Growing Corporation at St. Augustine, Trinidad. (*Tropical Agriculture*, Vol. III, No. 4, 1926).

581. EARL S. HASKELL of Tulane University formerly an official of the United States Department of Agriculture, has been appointed Director General of Agriculture for Persia.

582. A biographical notice of Prof. HEINRICH IMMENDORFF, director of the Institute of Agricultural Chemistry in the University of Jena, of the Thuringian Regional Institute for Agricultural Research, and of the Observatory of Fluvial Hydrography at Vacha on the Werra, appears in the *Die Landwirtschaftlichen Versuchs Stationen* review (No. V-VI, 1926) edited by Dr. ERNST MISCHE, the occasion being that of the twenty-fifth jubilee of IMMENDORFF'S work as director. The researches made by Prof. IMMENDORFF with E. KEMPSKI on Calcium cyanamide as a fertiliser, are well known, having been for the most part published in *Calciumcyanamid als Düngemittel*.

583. Counsellor Prof. Dr. KARL LINTNER died on 12 April last. He was a renowned teacher and investigator of the chemistry of enzymes, particularly those embraced by the technology of agricultural chemistry. Since 1896 he had been professor at the Higher Technical School of Munich.

584. JACQUES LOEB. The *Journal of General Physiology* has devoted one number (Vol. VIII, No. 4, 1926) to the commemoration of this illustrious scientist. A notice of the death of this physiologist appeared in an earlier number of this Review (No. 4, 1924) giving a list of his principal works.

585. Dr. CARLO DA MARCHESETTI director of the Botanic Garden and the Natural History Museum of Trieste, has died.

586. Prof. GIAN DOMENICO MAYER, Professor of Farm Engineering and one of the most eminent of the staff of the *R. Istituto superiore agrario* at Portici (Naples), died on 10 July. Prof. MAYER gave a certain special direction to the study of his subject, as may be seen from his works. He was anxious that rigidly technical treatment, necessary for the analysis of the various divisions of the subject matter, should be linked with other aspects of the problems of farm engineering, and that accordingly the inter-dependence of the technical side with economic, social questions and those of agricultural science should be realized.

587. The death has been announced of Prof. JOSEF MUNZAR formerly lecturer in the Higher School of Agriculture at Brünn and later in the Academy

of Agriculture of Tabor. The Czecho-Slovakian Agricultural Academy of which he was a member, publishes in its *Mitteilungen*, No. 2, Vol. 2, an article on his numerous scientific works.

588. A loss to the scientific circles of the island of S. Domingo has been occasioned by the death of Sir H. ALFORD NICHOLLS, C. W. G., M. D., F. L. S. He was well known as the author of the " Textbook of Tropical Agriculture ", and had done much to develop the Dominica Botanic Garden, which is now one of the most interesting of the West Indies. He was also Principal Medical Officer of the Island.

589. Dr. N. HJALMAR NILSSON, for 35 years head of the Swedish Seed Association and director of the Experiment Station of that Association at Svalöf, has died at the age of 69.

590. With the death of JOSEF NOLC on 20th March last Bohemia has lost an old expert in the genetics of barley. He had actively employed himself in the production of selected varieties of barley. The one bearing his name is now spread widely through Germany and has brought to its author many honours and prizes, amongst which are an honorary diploma from the Austrian Government (1905), a gold medal from the same Government (1906), a first prize in London (1906). His literary works were not numerous, but his publication " Züchtung botanisch reiner Formen böhmischer Gersten auf Grund der erblichen Eigenschaften " (*Berichte der Versuchsanstalt für Brauereiindustrie in Böhmen* 1902) has remained a standard work, being a complete account of his investigations on barley.

591. Dr. HENRY FAIRFIELD OSBORN, president of the " American Museum of Natural History " has been elected a foreign member of the " Royal Society " of London.

592. CARLO VANCOUVER PEPER, for 22 years professor of agriculture of the United States Department of Agriculture and ex-professor at the Washington State College died at Washington on 11 February last at the age of 58 years.

593. Prof. CHARLES R. RICHARDS, director of the " American Association of Museums ", has been decorated with the Legion of honour by the French Government.

594. Dr. GUSTAVO SCHELLENBERG, lecturer on botany at the University of Göttingen, received the DE CANDOLLE prize of the Physical and Natural History Society of Geneva.

505. The death has been announced of Prof. BRUNO SKALWEIT, teacher of Farm management (" Betrieblehre ") at the Agricultural Institute of the Albert University of Königsberg.

596. On 6th May 1926, at the age of 79 years, another eminent biological chemist died, FRANZ VON SOXHLET *Dr. phil., Dr. med. et Chir. h. c.* and ordinary professor of agricultural chemistry.

597. The Agricultural Society of Lombardy has also granted a gold medal to Ing. CARLO STABILINI in honour of his great activity during the last fifty years in promoting national agriculture and particularly that of Lombardy.

598. At Cluj, in Roumania, the death has occurred of prof. D. STEFANESCU, general director of horticulture at the Roumanian Ministry of Agriculture.

599. Dr. LOUIS, TIETJENS sworn expert of the Chamber of Commerce and Industry of Berlin and director of the Laboratory in Berlin of the German Potash Syndicate died on 19th January last at the age of 68 years.

600. Prof. ERNEST H. WILSON, assistant director of the " Arnold Arboretum ", has been presented with the gold medal coined in memory of VEITCH by the " British Royal Horticultural Society ". He is the first American who has received such an honour.

Dott. G. A. R. BORGHESANI, *direttore responsabile.*

ORIGINAL ARTICLES

SERICULTURE IN PERSIA

Historical Sketch.

Persia has always been considered as one of the cradles of sericulture. It is thought that the rearing of silkworms was known there at the same time as in China.

The industry however had only slight importance up to the VIII century, a period when under the influence of the Arabs it began to be developed. At the end of the XIII century Geneva merchants bought silk from Ghilan. During the XV and XVI centuries, according to D. F. Lafont, numerous companies exchanging European goods, particularly sugar for silk and silk stuffs manufactured in Persia, installed themselves on the shores of the Caspian and of the Persian Gulf. Under the influence of this trade, sericulture developed rapidly and reached its zenith about 1669, with a production of 2 million kilogrammes of silk. Ghilan alone supplied almost half.

Towards the middle of the XVIII century, for reasons which have not been recorded, production decreased suddenly to such an extent that in 1750 scarcely more than 200 000 kgs. of silk were produced. That decrease was of short duration and in 1850 production went up again to a million kilogrammes, of which more than half was exported to Europe. Sericulture which was then, as these figures indicate, very flourishing, was hit by the terrible plague which ravaged Europe. Pebrine made its appearance in Persia about 1860. Production became almost nil, in 1885 it amounted to scarcely 40 000 kgs.

The drop in the price of silk in the European markets only accentuated the disaster. The breeding of silkworms was no longer successful. In many regions, especially in Khorassan, at Yezd and

Kachan, the plantations of mulberry trees were pulled up and replaced by opium poppy crops.

Pasteur's work having enabled the disease to be eradicated, sericulture was again encouraged in most silk producing countries.

This reaction however did not touch Persia, whose silkworm seed producing establishments were so ravaged by the disease that in 1867 she had to appeal to seed producers of Japan.

About 1890 some Greek seed producers introduced experimentally seed of the Baghdad breed. The results obtained being satisfactory, the importation of this seed increased rapidly in the Caspian provinces and began to revive on the Plateau. In 1906 close on 300 000 boxes were reared at Ghilan, 30 000 at Mazandaran and Khorassan and 4000 on the Plateau. Numerous firms installed suffocating and drying plant at Ghilan. There were in 1908 more than 70 of such installations, and during the same year about two and a half million kilogrammes of fresh cocoons were exported.

This period of prosperity was only to be of short duration ; the war occurred, the commerce of silks and cocoons was suspended. The Caspian provinces, especially Ghilan, were invaded, the sericultural establishments pillaged by the revolutionaries and bolchevist troops. The peasants, who could no longer sell their cocoons, again pulled up their mulberry trees and planted rice in their place, this being in demand for the provisioning of the armies and selling at a very remunerative price. After the war it was found more difficult to dispose of this product and silkworm rearing was again started. In 1924 about 40 000 boxes were reared in Ghilan ; in 1925, 90 000, and this year the market absorbed 100 000 boxes.

Present state of sericulture.

The restoration of sericulture is a slow process. The silk producing industry is hampered in its development :—

1) By the suppression of transit across Russia.

2) By the influence of exchange and the quality of the cocoons produced.

Before the war suffocated and dried cocoons in Persia were sent to Europe by the Caucasus. The low cost of transport enabled them to compete with cocoons from the far East..

The seed destined for the Persian rearing establishments also came through Batum and Baku.

As a result of the Russian revolution, transit was no longer permitted to foreign merchants, except in rare exceptional cases.

The despatch of cocoons being made in light but bulky bales, they could not be transported by caravans or by motor transport on account of the excessive cost which would be asked. Their export could only be effected economically through Russia, where transport is by boat and railway. The market is therefore to some extent monopolized by Russian companies. On the other hand, silkworm seed consigned to Persia is now sent by devious routes, coming either by Beyrout. Baghdad, Kermanshah, or by Trebizond-Tauris. The importers owing to the great risks they run (frost, premature hatching, etc.) sell them at a higher price. At the present time the Persian silk producer pays a great deal for the seed without knowing at what price he may be able to sell the produce.

Moreover, the high cost price of the cocoons owing to the superior value of Persian currency compared with the depreciated currency of importers (Italy, France) and their poor quality, causes them to be little in demand on the market, Japanese or Chinese raw silk is bought in preference.

The rearing of silkworms only gives the rearer a very small profit. That it is still practised is due to the cocoons being paid for in ready money and to the present scarcity of money in Ghilan. Many merchants of silkworm eggs even advance money to the silk producers to induce them to buy: the amount which varies from 5 kraus to one toman per box is then repaid at the time of production.

Conclusion.

Persia is preeminently a silk-producing country, the rearing of silkworms being practised in all Provinces except on the Persian littoral in consequence of very great heat and in a few regions unprovided with water or very cold. This industry can only be made prosperous by adoption of a thoroughly comprehensive silk producing policy.

In addition to expected improvements the silk producers must be educated, schools and experimental stations must be set up to seek the varieties of silkworms and mulberry trees best adapted to the different regions, for the distribution of mulberry plants, creation of nurseries for giving every encouragement to growers, and protecting them against sudden falls in selling prices. It should be ende-

avoured to make this production a household matter, that is to say that each person should rear a few boxes of silkworms eggs so as to increase his income and at the same time the national wealth, without however being too much affected in case of the always possible crisis.

L. R. DEBOUDEAU.
Director of the Persian Institute of Silk Seed. Teheran.

CLASSIFICATION OF CEREALS.

CAN THE AMERICAN SYSTEM OF CLASSIFICATION BE APPLIED IN EUROPE?

In a paper published recently in this Review (1) it was stated, among other things, that the Roumanian Government was very deeply engaged with the question of the storage of cereals, examining the possibility of introducing the American system, with standardization, classification and certification. In that paper only the expediency of introducing into Roumania this well known and much boasted American system was dealt with, and it was then noted that this system, so far as constructive technic and machinery were concerned — silos and elevators — had begun to be general even in Europe in centres with a brisk trade in cereals, but that as regards commercial technic (standardization, classification and certification) it was not adopted in Europe.

We think that it might be interesting to study the question from this more general point of view and to investigate the causes which prevent the adoption in Europe of a system of commercial technic which has given such splendid results in America.

We propose to do so, but with this object we must begin by investigating the American system as a whole, without too much detail. The problem which we are dealing with is mainly one of storage, *i. e.* the concentration of stocks of cereals in the most important centres, classification and other operations which we shall examine later being only accessory operations, though also very important. In America, as everywhere, the original object was purely and simply that of a more convenient system of storage, capable of handling easily large quantities of cereals at the least possible cost; it was possible to effect this by means of improved mechanism, by automatic unloading and weighing, elevators, etc. on the one hand and the system

(1) Vol. III, October-December, 1925: "Situation of the Growth and Commerce of cereals in Roumania".

of silos with vertical cellular compartments on the other, a system allowing of a more rational utilization of the accommodation so provided and cheaper handling by automatic unloading of the cells.

This system of storing silos, elevators etc. has been introduced all over Europe and works admirably.

But in America the storage system was not considered complete here but was made to embrace also accessory systems of commercial technic, namely : — standardization, classification, certification, and warrantage, operations entirely independent of each other and especially independent of the actual system of storage.

To avoid any possible confusion we will first of all examine briefly each of these operations :—

(1) *Standardization* has for object the fixing each year of types of different quality categories for each kind, types represented by samples, termed " standards ", serving as basis for the classification of the respective cereals.

(2) *Classification* has for object the sorting of the cereals, by kinds, into quality categories, each subdivided into quality classes.

Classification, that is to say sorting into quality categories, follows the lines of the above mentioned standards, after which comes the subdivision of each quality category into classes.

There are therefore several quality categories for each kind of cereal (wheat, rye, maize, barley, and oats), according to the province of origin, the kind of crop (autumn or spring sown), the colour and other indications of this kind, as for example for wheats :— hard or soft. Then, for each quality category there are several classes formed on more or less recognized lines, such as the relative weight (relation between volume and absolute weight, generally expressed in kilogrammes per hectolitre), the percentage of foreign matter, and the conditioning, that is to say the keeping power of the goods.

(3) *Certification* consists in the fact that each consignor (the person who deposits the cereals) receives from the management which receives the deposit of cereals a certificate recording the making of this deposit, indicating the quantity, kind, quality category, class and other indications of an administrative kind.

There now comes in the essential point of the system : this certificate is not a document of the ownership of the goods deposited, but a document giving right to an equivalent quantity of similar goods of the same category and class.

This point is very important, for owing to it the goods deposited

are exempted from preserving their individuality, *i. e.* the management of the warehouse is not obliged to keep the goods separate for each owner, but mixes them according to category and class without troubling as to whom the different parts in each category and class belong; this is possible owing to the fact that the management is not obliged to deliver the actual goods deposited, whether on the spot or elsewhere, but only goods corresponding to the same category, class and conditioning.

It is chiefly in this, and we might almost say solely in this, that the great advantages of the American system lie, advantages which may be summed up as follows :—

1) Economy of space in the warehouse, for it is not obligatory to reserve cells of the warehouse for each owner even for the smallest quantity, or to wait until each owner has sufficient goods to fill the cell already engaged. By mixing the goods of several owners the cells are quickly filled and the charging of full rates for use of nearly empty compartments is thus avoided.

2) Facilities in transport, since it is not necessary to wait the arrival at destination of the goods consigned, but other equivalent goods, already available, can be delivered.

3) Facility of business dealings, since the risks of differences of guaranteed quality, quantities and of terms of transport, are undertaken by the management of the warehouse.

But to realize effectively the advantages enumerated in these three paragraphs, there are 3 *sine qua non* conditions without which the whole system become illusory or onerous :—

1) Very excellent transport facilities must be available so as to be able to meet every exigency without delay.

2) Very large quantities must be handled , with a very brisk turn-over, to ensure a return on the great amount of capital invested without being obliged to charge the consigners burdensome rates for storage.

3) A well chosen staff, exceptional both as regards professional capacity and especially as regards absolute trustworthiness is necessary.

It remains now to be seen :—

(*a*) Whether the countries of Europe are lacking in system of commercial technic in their European organizations, and whether the European cereal trade is really chaotic or not.

(*b*) Why European States have not yet adopted the American

system known as "*classification of cereals*", if it is really superior to the European systems.

* * *

Contrary to general opinion (except of course that of experts), cereal trade in Europe has an excellent organization of commercial technic, which though relatively old, has proved its superiority for European conditions and is still quite adequate to deal with any such, however pretentions, which have been formulated in Europe. We speak, of course, exclusively of the commercial technic side. Let us now see what this commercial technic in the European system is.

The principal object in all systems is that of enabling the two contracting parties, seller and buyer. to come to an agreement with the greatest possible precision, even at a distance, regarding the different qualities of cereals offered and regarding the conditioning of these cereals.

This is how Europeans long before Americans solved the problem :

There are for qualities :—

(1) "*Sealed samples*", authentic samples of the goods offered are delivered and it is guaranteed that the goods delivered will agree with the sealed sample. In English the clause is "*as per sample*".

This method is used especially for superior qualities, since it enables the full value of such goods to be realized.

In the American system, full valuation for a fine quality is impossible, for in making quality classes it is not possible to make an infinite number of divisions and it is also impossible to admit special mention for exceptionally fine qualities, as the goods no longer preserve their individuality ; on the contrary, each class, even the very best, only represents an average of qualities admitted in the respective class, of which there is in each class a higher and a lower limit for admissibility in that class, whence it results that the higher limit will always be sacrified in favour of the lower limit.

In the American system the object sought is not so much full valuation of the quality as that of the formation of large lots of goods of each class, so as to realize in this way the other advantages of the system ; *i. e.* something is sacrificed on the quality in order to gain advantages in handling, storage, transport, transfer, etc.

It is certainly a question of convenience, of calculation, but in order that this calculation should show that the American system is

right we should have to consider all the American conditions, conditions quite different from those of Europe.

In any case, one thing is certain, namely that the American system in no way pretends to wish, as is suggested by certain persons lacking knowledge in Europe, to raise the value of the qualities of cereals and thus contribute to the selection of qualities, such an aim on the contrary being achieved rather by the European systems.

(2) "*Types*". — These are again samples of goods like the previous ones, but of a more general character than the latter, for in this case it is no longer a question of presenting an authentic sample taken from the goods offered, but only an informative sample, so to speak, which enables a more or les sprecise explanation of the qualities offered to be made at a distance.

This method, less rigid than the previous one and always subject to a margin of fluctuation fixed by custom, perfectly regulated and mentioned in the type contracts, has especially the advantage of informing the markets, both home and foreign, regarding the different qualities of cereals produced in the country in the respective year. These "*type samples*" have on the other hand a more or less fixed character, generally for dealing with one season's crop; goods are always so described by each selling firm and it is enough to mention this number in offers, correspondence or contracts.

(3) "*Special indications*". — In this case the samples are replaced by a description of the category of quality, giving origin (province, region, district) colour, etc. and indicating the weight per hectolitre and the percentage of foreign matter all according to guarantee or taken as basis of the agreed price, compensating reciprocally for excess or deficit.

Generally this method is used in combination with the previous method, that is to say the *type samples* with *special indications*.

(4) "F A Q". — Word composed of the initial letters of the three English words "*fair average quality*" but it is customary to add "generally recognized at the time and place of lading", as the average quality may vary according to the region of origin and according to the time. This method, being in use in international commerce for the bulk of the cereals sold, is very interesting, as it is especially the qualities without special pretentions which form the bulk of imports and exports. But what is especially interesting in this method is the means of determining the "fair average quality at the place and time of lading" that is to say the control of this determination.

The control is done by means of "*standards*" that is to say type samples taken from the cargoes of different origins for each month; there "standards" are taken by agents of the corn exchanges and kept at the disposal of interested parties in case of need.

These "standards" are certainly the origin of the American classification; but, nevertheless, these two things should not be confounded, for the "standards" which we are now dealing with have only as object a basis of control in case of doubt or dispute, while the standards in the American system are type samples serving as basis of classification, that is to say for the distribution of the goods in groups of categories and quality classes. The standards with which we are here dealing exist not only for cereals but also for a number of other goods, especially for textiles, and it is only in this sense that the idea of standards generally spoken of in the commerce and industry of many articles should be taken.

* * *

As regards the conditioning of the goods, that is to say the keeping power or shall we say, the sanitary condition of the goods, the following three clauses are in use:—

(1) *Good merchandise sound and dry.* — Every cereal, to be considered as good, sound and dry, should on handling give the sensation of being cold and free from moisture; the slightest temperature which does not feel cold to the touch indicates the start of fermentation.

(2) *Such as it is*, is a clause which indicates that the buyer accepts the goods with the conditioning such as it is, that is to say that the buyer takes the risks of conditioning on himself. However custom, which is always conceived in a spirit of equity and has its basis on reciprocal loyalty, adds: — (the goods should be sound at the time of lading).

(3) "*Rye-terms*" or rye clause ("slight dry heat to be considered as good") means in usance that certain cereals heat during transit, but being sound and dry cool easily when they are placed in the open air. This is especially the case with rye, whence the expression "rye-terms", but it occurs also with maize, for which reason shipments of maize are almost exclusively dealt with under this express clause.

From what has been said we are easily convinced that :—

(1) There exists in Europe and elsewhere, as well as in America, a system enabling agreement to be reached with precision at a distance regarding the qualities of goods and their conditioning.

2) This system, which we may call the European system, is less rigid than the American system and it moreover permits the full value being given to superior qualities, so that it may therefore rather encourage the selection of cereals.

(3) In the American system quality is partly sacrificed to advantages gained by other sides of the system :— promptness in delivery, economy of space, facility of transfer.

In this manner we have answered the first of the two questions which were formulated above namely :—

(*a*) Whether the countries of Europe are lacking in system of commercial technic in their European organizations, and whether European cereal trade is really chaotic or not ?

The above notes offer an explicit answer thus :— The cereal trade in Europe is by no means chaotic ; it has a system of commercial technic which was formed and improved successively in accordance with European methods, means and exigencies.

As regards the second question formulated above :—

(*b*) Why European states have not yet adopted the American system known as " *classification of cereals* ", if it is really superior to the European systems.

Although the reply might be deduced from what has been explained above, we consider it useful all the same to insist more fully on this point to avoid all possible confusion. First of all it must be clearly noted that in the American system there are two perfectly distinct parts : — the contruction and mechanism part (silos and elevators) on the one hand and the commercial technic part (standards, classes and certificates) on the other.

The former is a question of storage, while the latter is simply a question of commercial technic.

The summary description of the American system given above shows that the first part, that of storage, can exist alone without the second part.

The converse does not hold good. The second part, that of commercial technic *American system* (classes and certificates) cannot exist and would have no reason for existence without the first part.

But that is not to say that another system of commercial technic cannot exist and function independently of the system of storage. Proof of this is furnished by what happens in Europe, where the commercial technic, very well organized up to the minutest detail, functions quite independently of the system of storage, very varied and often precisely identical with American storage silos and elevators.

In these conditions a question very naturally arises :— With the introduction of storage silos and elevators on the American system in large numbers into Europe, why was the European system of commercial technic persisted in ? Why was the second part of the American system obstinately rejected ?

The answer is very simple :— Because the conditions both of agriculture and commerce and the means of transport in Europe are entirely different from those in America.

Nor should it be thought that it is for lack of large quantities of cereals to be handled that countries in Europe are indifferent to the American system ; this might be true for certain European countries, but not for all.

The following table show that there are countries in Europe without classification, with a higher production of cereals than that of certain countries of America having the classification system ; such is the case of Germany and France compared with Canada, each of these two countries having a higher production than that of Canada. But what is still more characteristic is that France has a foreign commerce in cereals almost as large as that of Canada, while that of Germany is more than three times as large without having felt the necessity nor even the utility of introducing classification of cereals.

Great Britain, which has a relatively small production, has a foreign trade in cereals more than three times as great as that of the United States or of Canada. It must not be thought that a distinction is obligatory in this respect between importing and exporting countries for cereals ; the proof of this is furnished by the United States which, with their enormous production of over 1000 millions of quintals, only exported about 3 %, the classification of which is mainly for home trade. Canada only exported 20 % and Roumania exported 48 % of her production.

TABLE I. — *Average 1909-1913 in quintals.*

Countries	Grains	Production	Imports	Exports
Germany	Wheat	40 430 840	24 217 109	3 318 357
	Rye	101 318 075	3 893 220	7 940 578
	Barley	30 402 183	30 828 567	26 005
	Oats	86 186 182	5 569 857	4 156 356
	Maize	731 250	8 169 208	399
	Total	259 068 530	72 677 961	15 441 695
France	Wheat	88 626 740	10 388 937	47 603
	Rye	13 335 930	527 424	6 888
	Barley	11 501 564	1 376 643	173 017
	Oats	53 482 672	3 972 371	16 887
	Maize	5 661 834	4 745 954	25 315
	Total	172 618 740	21 011 329	269 710
Great Britain and Northern Ireland	Wheat	15 874 779	52 488 168	205 987
	Rye	—	411 367	1 692
	Barley	12 622 698	10 866 439	21 948
	Oats	23 551 816	9 151 179	171 275
	Maize	—	21 135 503	344 698
	Total	52 049 293	94 052 656	745 620
Roumania	Wheat	23 893 233	48 185	13 362 640
	Rye	1 188 441	9 536	903 477
	Barley	5 440 528	16 991	3 525 335
	Oats	4 216 174	7 623	1 566 887
	Maize	27 302 810	60 242	9 897 281
	Total	62 041 186	142 577	29 255 620
Canada	Wheat	53 647 786	55 363	20 207 138
	Rye	531 980	7 878	26 729
	Barley	9 857 335	18 306	1 047 228
	Oats	54 237 610	12 941	1 816 277
	Maize	4 393 719	2 655 059	4 349
	Total	122 668 430	2 749 547	23 101 721
United States	Wheat	187 819 793	255 876	14 510 438
	Rye	9 168 085	—	145 345
	Barley	40 237 182	—	1 627 879
	Oats	165 965 468	632 820	1 189 603
	Maize	688 967 478	751 714	11 010 736
	Total	1 092 158 006	1 640 410	28 484 001

But the most characteristic example is furnished by Germany which has a very high production (260 millions of quintals) and at the same time a very appreciable foreign commerce in cereals, both as imports (72 600 000 quintals) and as exports (15 500 000 quintals) while Canada exported 23 000 000 quintals and the United States 28 500 000 quintals in round numbers (1).

Germany has then a very large home trade in cereals, in short she contains, more than any other country in the world, all those elements which might seem to justify the introduction of the system of classification of cereals, and yet she has abstained from doing so. What makes it all the more interesting for our thesis is that Germany is not a country which has neglected the problem of storage of cereals, on the contrary she has made further progress in the matter than any other country in Europe.

Germany has encouraged associations for storage of cereals in every way, and it is owing to such encouragement that there are at the present time in Germany a very large number of warehouses for storing cereals, for the greater part on the silo system and all having quite modern elevators, cleaning apparatus, etc.

Despite all this apparatus and plant and despite even its organizations, which make it easy for cereal producers to have sales in common, Germany, which has all that could be desired in this respect, has resisted the temptation to introduce into her country the commercial technic of the American system represented by the classification of cereals.

If such is the situation for Germany, all the more reason for other countries, finding themselves situated in less favourable conditions for an American system, to abstain from that system in spite of the magnificent results which it has given in America.

This once more proves that what is excellent in America is not always practical in Europe, seeing that circumstances and means are quite different.

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(1) As is seen in the statistical tables given above (taken all from the *Yearbook of Agricultural Statistics* of the International Institute of Agriculture of Rome) we have taken the averages of five pre-war years, since the post-war situations are everywhere more or less abnormal.

SCIENTIFIC MANAGEMENT OF AGRICULTURAL LABOUR, ITS DEVELOPMENT IN GERMANY AND ITS INTERNATIONAL IMPORTANCE.

The last century was one of enormous progress in German agriculture, a fact too well known to need further demonstration here. Equal progress was made in other countries. No doubt one of the causes was the development in agricultural science. The father of agricultural science in Germany, Albrecht THAER, pointed out that agriculture can be regarded either as merely physical work, or as an art or as a science. But even to-day agriculture still lacks scientific application, and agricultural science itself still requires considerable development. This development however depends itself among other things on the state of agriculture at the time, the general economic position, and the degree of development of science in general and of natural science in particular. Many of the great advances in chemistry, in physics, in zoology, in botany, in the science of heredity, organization and other spheres have found expression in important developments in agriculture. In this place we shall only mention, from among scores of others, two names whose scientific work has benefited the whole world, Justus LIEBIG and Gregor MENDEL.

The attention paid to the different branches of agricultural science at different times has been very different. So long as it was merely a question of increasing the yields, the conditions being such that increased gross yield meant increased net yield, the branches of agricultural science which received the greatest attention were the natural sciences e. g. plant-structure, cattle-breeding, etc. In time of bad prices more attention had to be paid to the economic side of agriculture and aid was sought in economics.

The consideration given by agricultural science to the problem of agricultural labour was also very different at different times. Thus THAER in his standard text-book "Grundsätze der rationellen Landwirtschaft", when considering the general question of agricultural labour, deals very fully with the problem of the skilled labourer. Similarly

Johann Heinrich von Thünen, treats in his "Isolierte Staat" very fully of the problem of labour and wages. Later this side of the problem was again neglected and plant-structure and cattle breeding again came to the front. It was not till the eighties that two authorities on agricultural management von der Goltz and Pohl laid stress on the human factor again. The latter also made the first and a very successful attempt indeed at a practical and scientific analysis of human labour. Again recently it was Aereboe who, as in other works too, in his "Landwirtschaftliche Betriebslehre", emphasized the importance of the human labour problem in agriculture and made useful suggestions. He suggests that nine-tenths of the problem of agriculture consists in the management in human material.

Before the war in Germany much attention used to be paid to the problem of agricultural work by the management section of the German Agricultural Society, and the chief of that section, Oekonomierat Dr. Stieger never lost an opportunity of impressing on hearers its importance, when speaking at any one of the many travelling exhibitions. It was also he who first made an attempt to form this problem of agricultural labour into a separate and distinct section of agricultural science, and his ideas on this subject can be found in his book "Der Mensch in der Landwirtschaft" published in 1922.

All this very promising work in Germany suffered a setback during the war. In 1919 the author of this paper gave the lead in starting experimental work on the agricultural labour question, making use both of the work of Frederic W. Taylor and of the psychotechnical methods employed for years in industry. But for this type of work both an experimental farm and a scientific institute were necessary. This need was soon supplied by the Government of the Free State of Saxony, who not only offered but also equipped the Pommritz estate and thus made possible the work of Prof. D rlitzki, whose name soon became famous in Germany and abroad. The aim of the author at that time was to improve all kinds of agricultural work by exhaustive scientific studies, and then, making use of the results thus obtained, to educate and train the agricultural worker accordingly. This work did not remain confined to Pommritz, for soon it was also begun at Landsberg a. Warthe, Königsberg i. Pr., Stettin and by many practical farmers who got interested in it. A small journal also began to be published, as can be seen from the bibliography at the end of this paper. Scientific employment of agricultural labour began to be included in the curriculum of many colleges, and there is no

doubt, that its neglect for so many years will be more than compensated by a very rapid development in the next few years, for which the action of the colleges will be largely responsible. Agriculturists were at first sceptical, but are now convinced apparently of its soundness and are readily applying its principles. In a few years time some of the results and ideas of its science will be shewn to be for the common good of agriculture. The importance of its study is enhanced very considerably by the knowledge that its results may enable us ultimately to reduce very considerably the wages bill, the largest item in general working expenses, of which it seldom forms less than 30 % and often more than 50 %.

As in other branches of agricultural or other sciences further development depends on international effort, which implies a certain give and take between nations, and I have no doubt that the German scientist will worthily fulfil his part. I shall now attempt to give a brief account of what appears to me to be the specific German, and the general international problem. Though we shall concern ourselves mainly with physical work, we must not forget that there is hardly any work which requires greater mental effort, and that in any case physical and mental effort is closely related.

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Competent work can only be done by the competent. Hence the first and last problem and the very basis of the matter consists in the creation and preservation of a suitably competent and skilled rural population. But in Germany, as in other industrial countries, a process very alarming for agriculture has been taking place in the last decades. The quantity and quality of its rural population has been constantly diminishing, thus, while in 1882 the land and forest workers in Germany numbered 3,975,204, in 1907 they were only 3,388,892 strong, including 387,329 aliens, showing a decrease in rural population of very nearly a million, which must be considered as a very serious loss to agriculture especially when thinking of future sources of labour. According to HAINISCH's "Die Landflucht" the same has been observed also in other countries.

The rural population must be physically, mentally and morally fit, and hence it appears to me that racial hygiene will have to be our first auxiliary science. That undesirable leakage of emigration must be absolutely stopped, and its opposite must be aimed at. No doubt

it would be an excellent thing if we could apply to man the ideas applied and tested in the case of animal breeding; in fact the marriage laws of the different countries are modest attempts in this direction. Propaganda might achieve much.

For the proper judgement of the human body and its abilities we must get a fuller knowledge of its anatomy and its mechanics.

It has to be taken into account that the upbringing and rearing of the young in country districts is not such as to result ultimately in a healthy and strong man, even granted the best hereditary predispositions. Thus infantile mortality in the country is much higher than in the towns. But proper rearing is not only of importance for the proper building-up of the body but in the last instance, it also determines that body's ability for work. If only for that reason alone our problem will have to concern itself with nutrition and there can be no doubt whatsoever that its study, particularly in times of highest mortality, in the different countries and localities will lead to important conclusions. Just as we cannot judge properly the human body without an adequate knowledge of anatomy, so, in the study of the problem of nutrition we shall have to make use of physiology and of the physiology of nutrition in particular. Undoubtedly it is just as important for man as it has rightly been considered to be for animals.

But skill as well as physical strength is essential to the agricultural labourer especially with the advance in quantity and quality of machinery used. That skill must be gained by appropriate bodily exercises, and the introduction of the spirit of sport into agriculture will help much in increasing the pleasure of work.

The prevalent view, not confined to Germany, has been that even the feeble-minded are suitable for agricultural work. And as HAINISCH tells in one of his books, in some districts of France the healthiest and cleverest children emigrated to town, while the weak, physically and mentally, stayed in the country and were absorbed into agriculture. Yet as a matter of fact there is hardly a profession which calls for so many abilities, so much knowledge and understanding as agriculture. The intelligent worker will always find scope for his intelligence in agriculture. Unfortunately, however, the rural population is provided with schools and other educational facilities on a much poorer scale than the urban population, and very much more still remains to be done in Germany for the land worker by improvement in educational facilities.

Any, even the simplest, agricultural work is performed not only with the body but also with the heart and soul. Where there is no love for the work, there can be no pleasure derived from it, and no proper will to work can exist. The will to work is the motive power, the steam, without which even the most perfect engine cannot function. Much will also have to be done in this direction to improve the human material. Though education, which must start early, can help much, yet its powers are somewhat limited, since it can never completely eradicate a hereditary inclination to laziness. And so psychology appears of paramount importance, and on experimental psychology we shall touch later.

The size of the farm has a considerable influence on man and his work. Where the farm is small, a man is closely bound up with it and the soil, and where the labour is provided by the family the interests of all are the same. But, as the size increases more and more, outside labour has to be employed, lacking any natural interest in the farm. That interest must therefore be artificially created and maintained. With increasing size it becomes increasingly possible to use machinery, and to employ special workers for special work, and to introduce a division of labour. The small sized farm is handicapped in all these respects, and no amount of co-operation will overcome this handicap. However, it is not true that this particular science can be only or mainly of advantage to the large sized farm, though its benefit to a smaller farm may take another form. This is of the greatest importance to Germany, where three-fourths of the total cultivated land is in the hands of the small or medium sized farmer.

It is just the ordinary manual work which has so far received too little attention, and I do not doubt that much of it could be improved with a resulting increased productivity. If manual work is of the greatest importance on the small farm, its importance is not much diminished, despite introduction of machinery, also on the big farm. These considerations will hold good in other countries. True the intensity of working will make a difference, e. g. the big American wheat farm can use a greater proportion of machinery. And the more one passes in the direction of crops needing intensive cultivation e. g. potatoes, turnips etc., the greater becomes the need for employing manual labour. It would be very desirable to get, by means of international comparisons, information as to requirements of labour at farms of different sizes and under different systems of management. To make such figures comparative the work would have to be carried

out under the direction of some central authority, and a lead in this respect from the International Institute of Agriculture would be welcome. (*)

No doubt the most important branch of agricultural science still remains the performance of agricultural work, i. e. the relation between man and the object of his work, whether through the intermediary of tools or machinery, or not. Agricultural work, even in Germany alone, and no doubt much more so in other countries, is very varied. This can be partly accounted for by different climatic and soil conditions, by the different systems of management, by the different types of work to be done and no doubt by the human element and the different level of civilisation attained at any given time. In many cases however, in fact generally, the above explanation does not appear satisfactory or sufficient, when one considers the simple hand-tools, hoes, shovels, scythes, forks etc. which are used in the most diverse forms for the same work in different places, or again the plough share. General geographical investigations however on some of these tools, e. g. rakes and spades, carried out in Germany lead to the conclusion that, it is not as would appear, an adjustment of the tool to the conditions of work, with which we are here dealing, but that use is here rather a question of tribal peculiarity. More exact and local investigations showed that often in a very limited space e. g. two neighbouring villages we find the greatest diversity in tools employed for the same purpose.

These deviations and peculiarities become even more striking when one considers the process of working itself. Although mechanisation of industry by the introduction of elaborate machinery or other similar arrangements may lead to success in some cases, still we must not neglect the simple hand-tool. And let it be said here to the credit of the industrial investigator that he does not forget it. Undoubtedly among the great variety of different tools in use, there are some peculiarly suitable for a given type of soil or for a given kind of fruit and this can always be found out by comparative working experiment's and by general observations. Investigations on these lines, has been begun in Germany but on account of its difficulties it will take some time.

This problem will have to be dealt with internationally. It would be instructive to make an inventory of the different tools used

* This has now actually been undertaken by the institute. *Ed.*

in the different countries, and to form somewhere a permanent collection of illustrations and descriptions. Who could give a better lead in this work also than the International Institute of Agriculture? Later on perhaps a collection of the different tools themselves could be formed. If a start were made in a number of different countries there would be greater hope of ultimate realisation of our aim. I should also like to draw attention to the great difference in the materials used for making these tools as well as to the differences in weight between them. Too heavy or too light tools tend to inefficiency.

Machines and bigger tools differ also in this respect from the small hand tools, that they are very often produced on a large scale in works, and thus may become products of international trade. But their importance does not lie even in this or in that they perform the work for which they were originally designed, but, in the fact that they do the work with very little human effort.

Now how are we to determine the different degrees of usefulness of the different tools? Only by careful study of their mode of working. In this we shall have to make use of previous psychological work, in its application to industry, and mainly that referring to time, movement and fatigue. This work can be carried out in one of two ways. Either, with the aid of the simplest tools in practice, or with the aid of the most up-to-date scientific apparatus in specially equipped laboratories. In practice, however, we shall confine ourselves, in most cases, to the elimination of the inappropriate e. g. the elimination of wrong movements etc. Investigations carried out so far in Germany prove, that just as tools can differ very considerably over a very limited area, so can the modes of doing different tasks e. g. the binding of wheat, planting of potatoes, etc. These differences, which, can only be explained by habit and origin, find expression also in practice, namely, in differences of work done. Only lack of space prevents me from quoting many examples, and no doubt many will occur to any practical farmer.

Investigations of the different agricultural tools and of the different modes of doing tasks shows how much more has still to be done for the perfection of the different, separate, agricultural tasks. But we must again proceed from analysis to synthesis, and, considering the totality of the agricultural tools, investigate first the different separate processes of working, and then compare them with each other. Thus it is possible to cut corn with a sickle but also with various types of scythes or mowing-machines. Binding and carting again can be

performed in different ways. The planting of potatoes too shows considerable differences, whether it be in the mode of preparing the field, or in differences of tilling implements used or lastly in the different ways of planting, by machine or by hand. The same differences are seen in every kind of agricultural work and probably apply in every country. These different modes of working are also a very important field for our investigations, which will have to be carried out with the aid of the above mentioned auxiliary sciences.

Besides very careful time observations the cinema will be a great help in this work, for, on the one hand it will enable us to gain a deeper insight into the different agricultural processes, and on the other it will be a very important educational aid, illustrating the correct methods of procedure in the different types of agricultural work. I would suggest, therefore, that the International Institute of Agriculture should form a collection of suitable films and photos, and by reciprocal exchange and lending make them available to workers in this field. In addition there would have to be available the results of working studies with a description of all the circumstances in which they were carried out. These external circumstances or so-called geopsychical phenomena are of the utmost importance.

The mode of farm operation employed is closely related to the size of the farm. To choose a very simple example. As the size of the farm increases the tillage which was originally done by hand begins to be carried out by oxen, the next size demands horse labour, till in the end we get to motor or steam power. Every kind of work will have to be reviewed separately, and, by taking into account all the existing circumstances, we should by suitable comparative experiments be able to achieve further progress.

The amount of work to be done is largely determined by the form of the farm, and the form depends to a large extent on the habits of living of the people. Where every one lives separately on his own farm some distance away from others, the farm is usually an uninterrupted whole with large easily worked divisions. Where, however men prefer to live in small or large or very large villages, the position and the form of the fields becomes and more unfavourable. The roads to the furthest fields are frequently very long, and the fields are often so small as to be incapable of being tilled otherwise than by hand. Such lands, because of their separation from the worker's dwelling, and the unnecessarily long distance to be traversed, cause a great waste of energy and therefore a poor return for the work and time spent.

But means of communications, roads etc. must not be forgotten as determining ultimately the pace of men, and the performance of the draught animal and scope of motor traction. On this question too exhaustive and exact numerical information from the different countries would be very useful.

The influence of the shape of the piece of land on the work has already been noticed but it has only recently been the subject of careful investigation in Germany. It has been found, as was expected, that in the case of animal traction work e. g. ploughing, the efficiency of the work rose with increasing distance of working but not indefinitely, for on distances greater than 600 metres the number of rest stops is much greater, a fact which decreased the efficiency. For hoeing work short distances give the best results, but optimum results much depend on the general working conditions.

The steading always necessitates a great deal of work. A consideration of steadings in the different parts of only one country, like Germany, demonstrates a great diversity of method employed. The explanation of this will be found both in the different size of the farms and in the different general conditions, but, even more perhaps in the peculiar and characteristic building and living habits of the rural population of the given district. It would appear an obvious necessity for the internal arrangements and the distributions of the different buildings round the steading to be such as to help in the performance of the necessary work with the least expenditure of labour. But this is very seldom found to be the case. In the majority of cases no notice is taken of this permanent avoidable waste of effort. A very important labour saving service would be the introduction of suitable mechanical implements into the barn, shed and outhouse. This question of proper arrangement and equipment of the yard and farm buildings has of late received much serious attention in Germany, to mention only the suggestions of ENDRES in his book " Der Gutshof von 1925 ". Once all concerned have realized that proper yard arrangement and building equipment must be also adapted to the general existing conditions, there can be no doubt that agriculture will profit greatly. True these or similar ideas have already found expression, although, from a different point of view, in agricultural architecture, but there the question of labour has not received its due share of consideration. Faulty yard and building arrangements, but more still unfavourable position of the fields, as pointed out before, account to a large extent for the excessive labour and time used per unit surface on the small

farm as compared with the large one. In 1907 in Germany the time and labour used by a 0.5-2.0 hectare farm as compared with a 100 hectare farm was seven times as much, while on a 2-4 hectare farm it was four times as much. The amount of agricultural labour permanently employed per 100 hectares of cultivated land was for the above three different sized farms respectively 94, 12 and 63.

With the question of work on the farm is bound up that of house work, for in agriculture the woman's work is of the greatest possible importance. For this reason the house-work should be made as easy as possible, and this could be best achieved by the introduction of suitable labour-saving appliances. However, hitherto the general arrangement of the rooms and the type of the domestic utensils in general use have not conformed to the requirements of modern domestic science. But in view of the great interest which women in all countries display in these questions, undoubtedly here too much could be accomplished by international effort.

But these questions belong more to the science of agricultural management, and with them we are not prepared to deal in greater detail here — such questions as :— how a farmer can best ensure a uniform labour supply all the year round, etc.

Much depends in agriculture on the proper use made of the available labour. Even the preparation of the work, first the general and then the special idea, determines considerably its ultimate failure or success. Here agriculture can learn from industry. It has been often pointed out that agriculture is badly handicapped by the fact that a sudden change in the weather may completely disarrange the day's plans. If so, it is one more point in favour of my contention that the day's plans should always be made with every possibility in view, so that at the shortest notice it should be possible to redispose the available labour and this with the least waste of time. In most cases it is the faulty and the badly thought out disposition of the labour which is the cause of the greatest waste of time, and lessens both the work done and wages earned. One of the things which will help very considerably in a proper work organisation is efficient book-keeping, and to the problem of devising a suitable system of book-keeping for agriculture we shall have to apply ourselves. Some very promising attempts in this direction are already in existence.

If we have been dealing so far with the external conditions of work, we must now return again, to the consideration of the human

element. We have been investigating so far how we can increase the worker's knowledge of his work, also pointing out that the proper will to work is perhaps of not less, possibly of greater importance. We are justified in saying that part of the German rural population which works on it own property has an enormous will to work, while the property-less part of the population i. e. the one which sells its labour, though having a will to work, has got it for evident reasons in a somewhat smaller degree. The question therefore arises. How can the will to work, and through it, the efficiency of its labour, be increased in this part of the rural population too? In answering this we shall have to consider the farms of different sizes separately. Where the work is done mostly by hired labour, as on the large farm, the interest in the work will have to be raised and maintained by economic means i. e. by the use of a suitable wages system on a sliding scale. The piece work system of wages, especially in the form of the *Pensum prämienlohnes* (work bonus) system is being used to an increasing extent in German agriculture, and is no doubt very suitable as an incentive to a greater effort. However, it is a very delicate idea, which will only yield desirable results in expert hands. Because of the constantly changing conditions it is almost impossible to lay down in agriculture any basic numerical relations between effort (work) and remuneration. Only properly conducted labour studies with a proper knowledge of all the circumstances in which they have been carried out can lead to success. But the success thus achieved is sometimes surprising. Cases are known in which simple transition from day wages to the work Bonus system led to a 100 % increase in efficiency of the work, and this, not through some momentary overstraining, but because of the better use made of his powers by the worker. The increased wage, for it is only right that the worker should expect and get an increased wage for an increased effort, is the best means of retaining the agricultural worker at his profession and on the land.

What is true of the worker is not less true of the farmer, although for quite different reasons. For, though not interested in wages as such, or in the systems of wage payments, yet he is intensely interested in the results of the work, since higher results mean for him higher remuneration, if one can use this term.

The success of the work depends sometimes also on the method of its performance. Thus it has been found in many cases, by ob-

servation and experiments, that working in columns, as is still the way of working in many operations, reduces the efficiency very considerably. And this because the least efficient among the workers determines the pace of working. Hence the general conclusion, that a number of equally skilled people is more efficient than a great number of differently skilled.

The best results are got when every one is performing the work for which he is best suited. The attempts to place people in occupations for which they are best suited, or keep them out of occupations in which they are least useful, has led to the introduction of vocational tests in the case of many of the town industries. This is easy in their case, because industry leads to a great number of uniform activities, which make possible the devising of suitable standards for vocational tests. The matter is quite different in the case of agriculture. The great variety of agricultural implements makes it very difficult indeed to devise suitable tests for given operations, and because of this difficulty vocational tests have so far received very little attention in agriculture. This difficulty is quite evident in the case of the small farm, but things are somewhat different on the large farm. Here in view of the employment of a certain amount of specialised labour e. g. at the machines, in the cattle-sheds etc., the devising of suitable vocational tests should not be so very difficult. Although no doubt the question of work will for some years to come be in the forefront of the problems occupying the scientific employment of agricultural labour, still it would be an excellent thing by international co-operation to develop and devise now appropriate vocational tests.

A further great problem will be the education for work. This must be begun early and appropriately carried out. Agriculture is in this respect in a much happier position than other professions. Attempts are being made in Germany, to provide every agricultural worker with a systematic professional education. If successful this will demand a quick provision of a large number of educational and experimental farm institutes.

For many years attempts have been made to create a greater sense of well -being among the rural population by enriching and raising the spiritual life of the country side, for only thus can we create that pleasure in work, without which no true will to work can ever exist. In Germany much has been done in this direction by the German Society for rural welfare under the leadership of

SOHNREY. A satisfied and an industrious rural population, which not only supplies the town with food and work, but also constantly with fresh blood, fresh energy and vigorous health, is the principal source of national vitality of every State.

Prof. Dr. W. SEEDORF,
Göttingen.

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THE SCIENTIFIC INSTITUTE OF AGRICULTURAL TECHNOLOGY AT KIEFF.

In 1924 the Ukraine (U.S.S.R.) was enriched by the foundation of a new scientific Institute of Agricultural Technology in connection with the Polytechnic Institute at Kieff.

The idea of founding such a scientific institute in the Ukraine and at Kieff is not very new.

About 20 years ago a number of people who viewed with favour the progress made by the Kieff section of the Russian Technical Society determined to found here an Institute which should be able to give answers based on actual experiments to the many theoretical and practical questions arising in agricultural Chemistry and technology. They considered that such an institute should be able to do experiments under conditions similar to those obtaining in practice, and should serve as the centre of a group dealing with that particular branch of work for the whole district.

To satisfy these conditions the Institute must be able to count on the collaboration of a number of well equipped scientific institutes and above all on an experimental Station fitted with apparatus similar though smaller to those used in the great factories. Although this was a good idea whose realization would most certainly have played an important part in the development and progress of the sugar industry in Russia, it was not carried into effect until the revolution owing to the technical Society's lack of funds for carrying out the entire plan. Strange as it may seem, the Society of sugar growers, who, one would imagine, should have been keenly interested in the execution of the scheme and have felt it a duty to help the technical Society with the necessary funds, did not welcome it, and the idea was dropped. After the Russian revolution in the month of October the administration of agriculture became centralised in the hands of the respective central organisations of the new government, and I then raised again the question of setting up this Institute of Agricultural Science.

PLATE XXIX

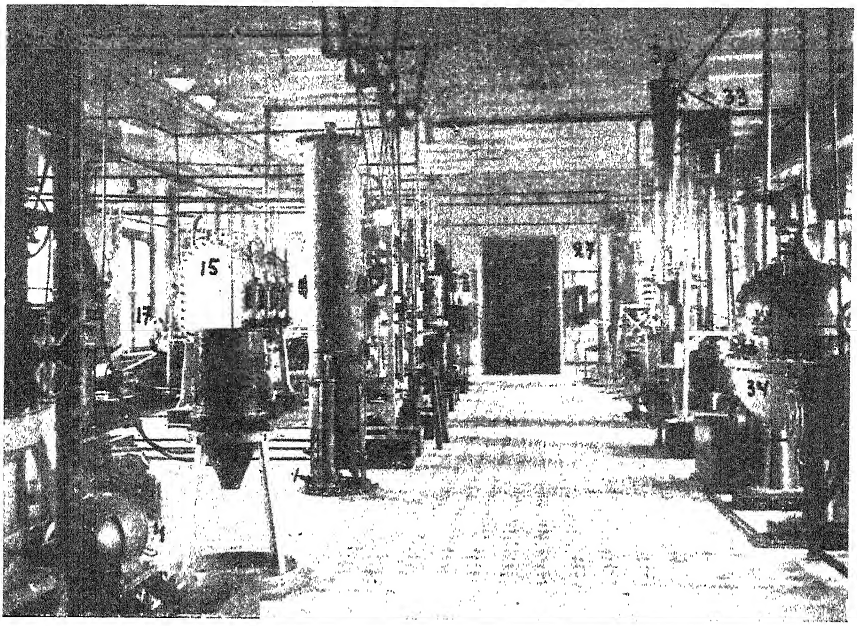


FIG. 103. — General view of the experimental Station of the Scientific Institute of Agricultural Technology at Kieff. (South Side).

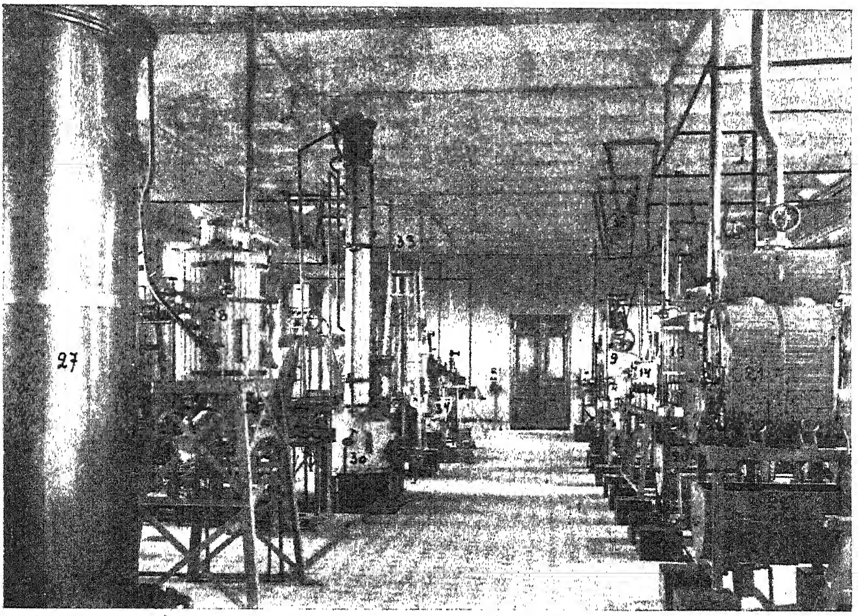


FIG. 104. — Same (North side).

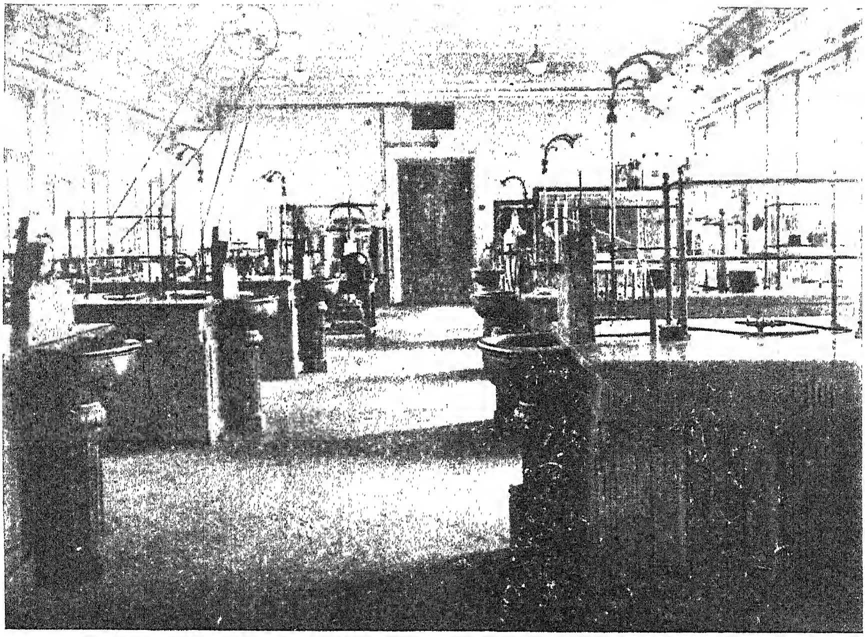


FIG. 105. — General view of the Chemical laboratory.

FIG. 106. — General view of the library and reading room.

PLATE XXXI

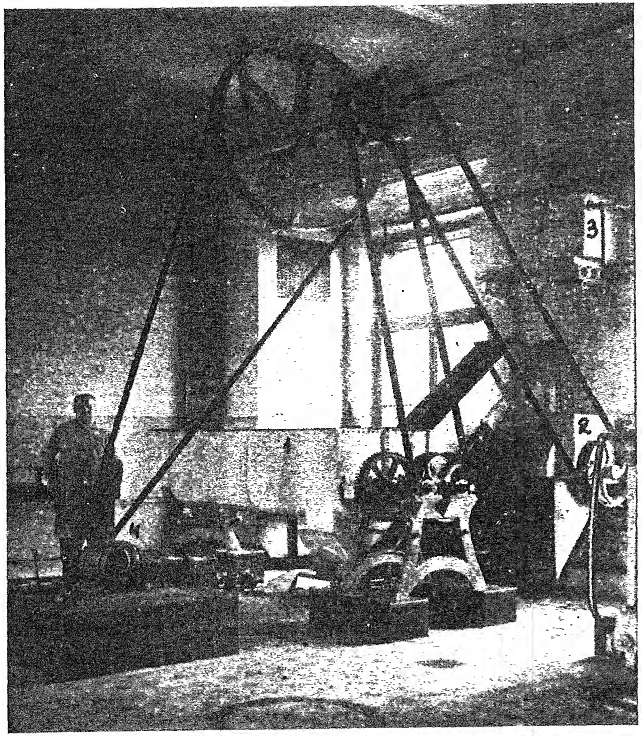


FIG. 107. — Experimental Station: 1) Washing apparatus — 2) Sugar Beet Slices — 3) Collector — 4) Motor.

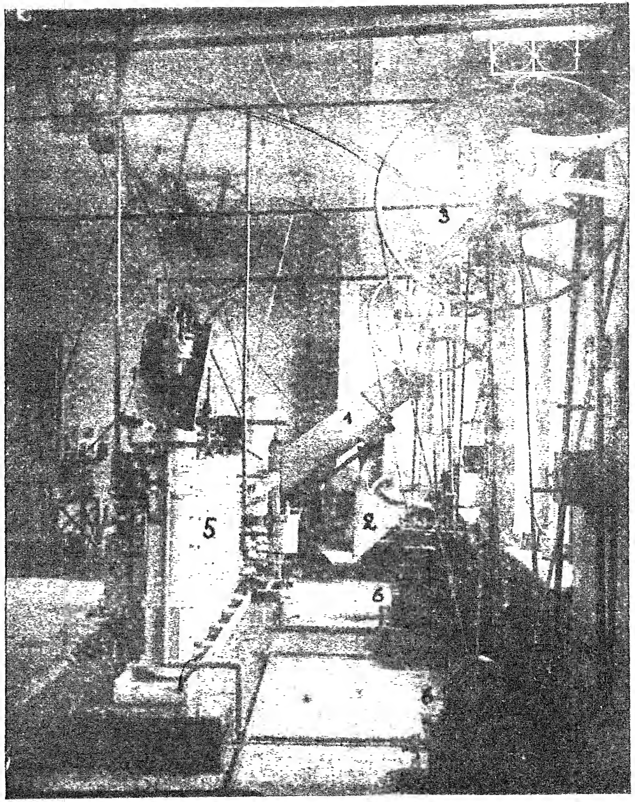


FIG. 108. — Experimental Station: 5) Diffusion battery continuous system Eng. E. KRAIENSKY — 6) Motor for forcing back the juice.

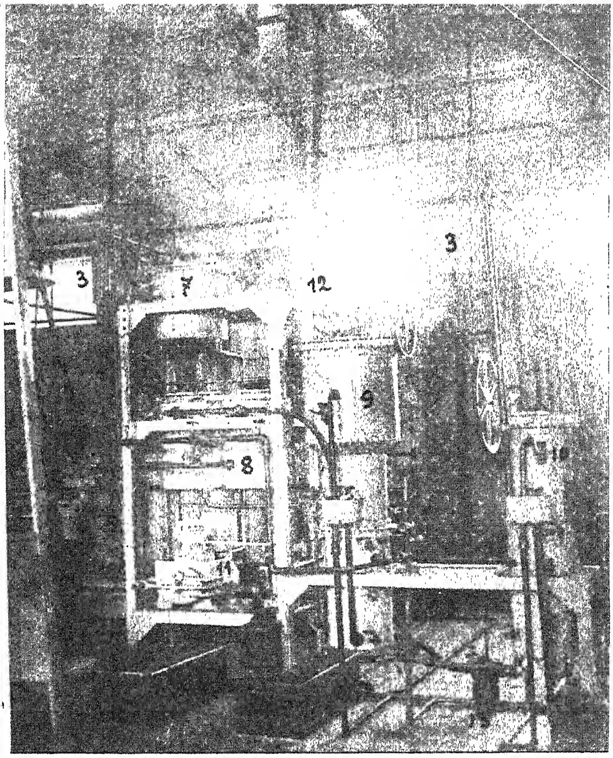
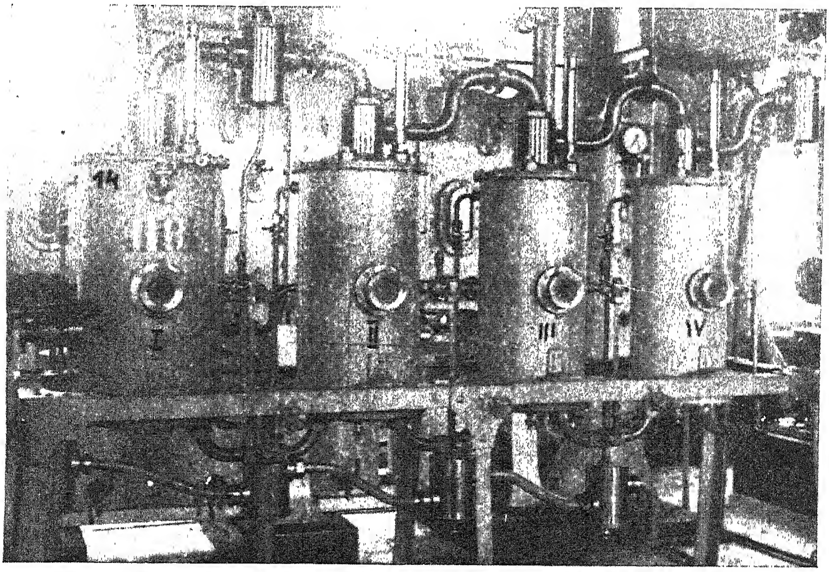


Fig. 109. — Experimental Station: 7) Milk of lime stirrer — 8) Two purifiers — 9) Continued action saturator, R. Ehrhard's system — 10) Continued action saturator Potapow's system — 11) Sulphur furnace — 12) Motor — 13) Automatic draining machine.



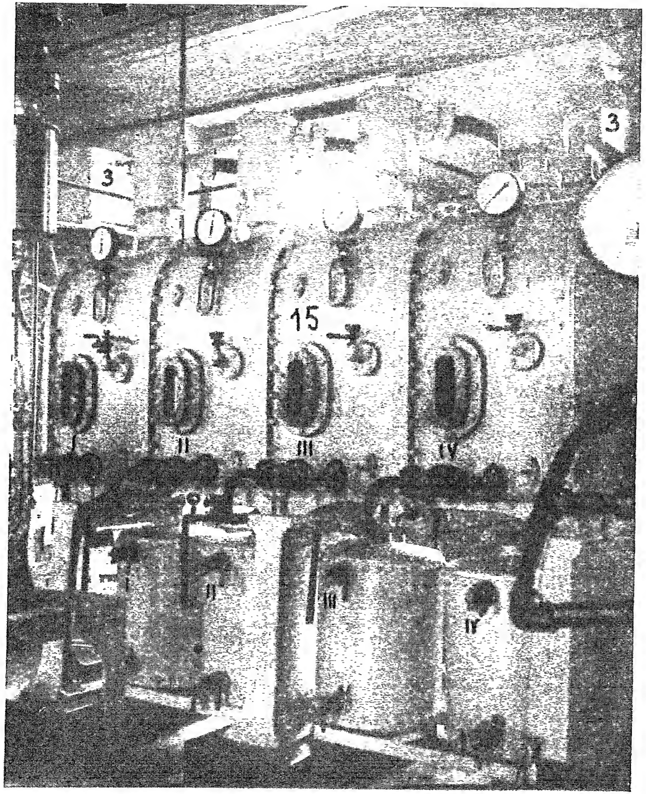


FIG. 111. — Experimental Station: 15) Evaporation battery quadruple effect, Eng. VITROVITCH system. I, II, III, IV, Cylinder bodies each with automatic draining apparatus.

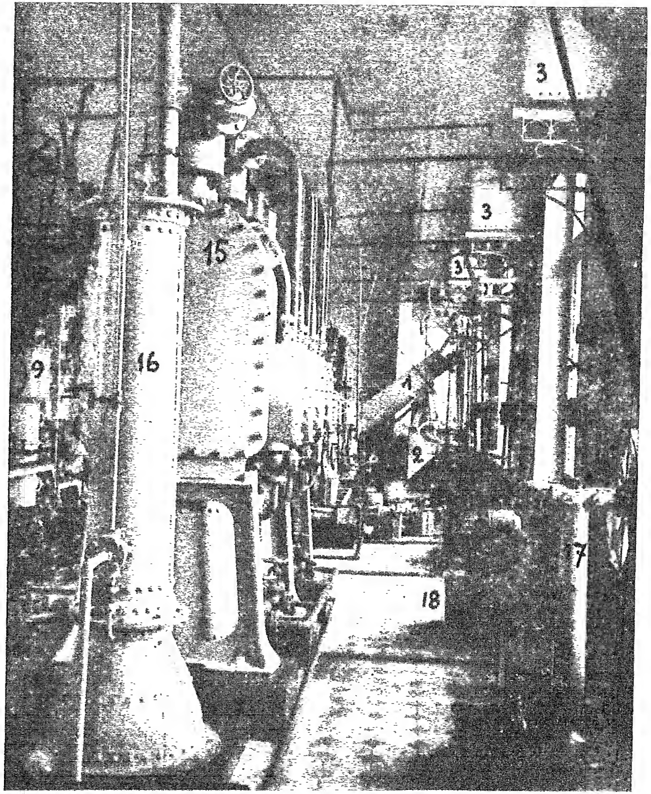


FIG. 112. — Experimental Station: 16) Dry Surface Condenser — 17) Pneumatic pump — 18) Motor for the pump.

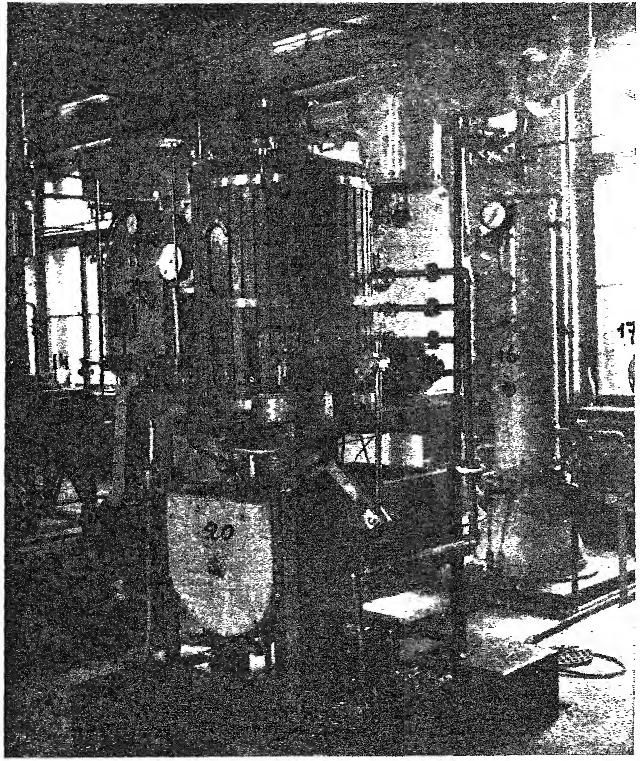


FIG. 113. — Experimental Station: 19) Vacuum pump for the sirup of the 1st Cristallisation — 25) Sirup stirrer.

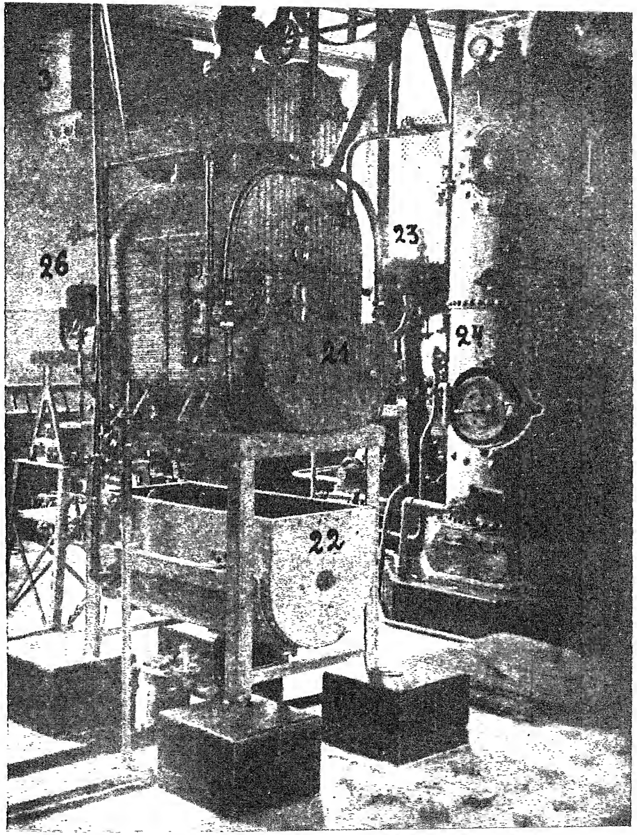


FIG. 114. — Experimental Station: 21) Vacuum pump for sirup of the 2nd cristallisation LEX GEROLD system — 22) Sirup stirrer — 23) Steam engine 9 kilowatts — 24) Steam boiler at pressure of 6 atmospheres.

PLATE XXXV

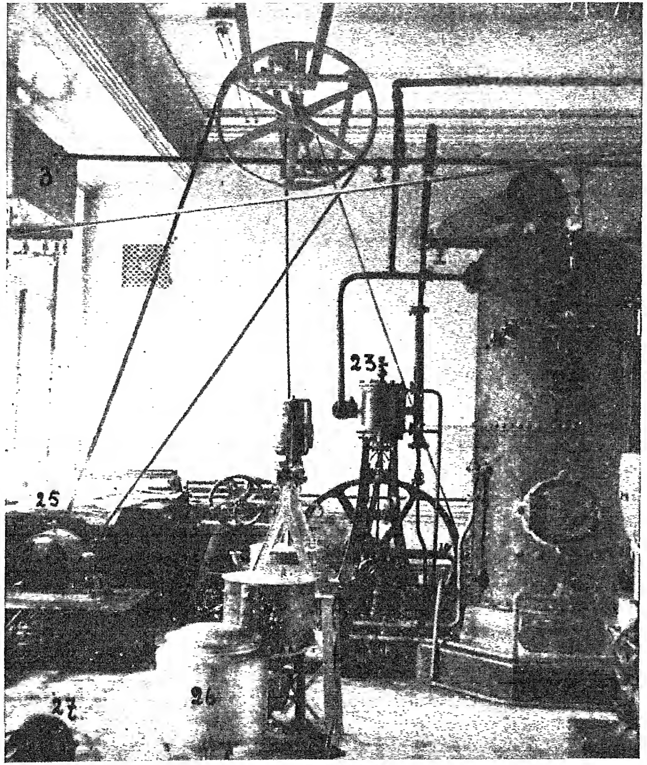


FIG. 115. — Experimental Station: 25. 8 Kilowatt motor — 26) 3 Centrifuges — 27) Motor.

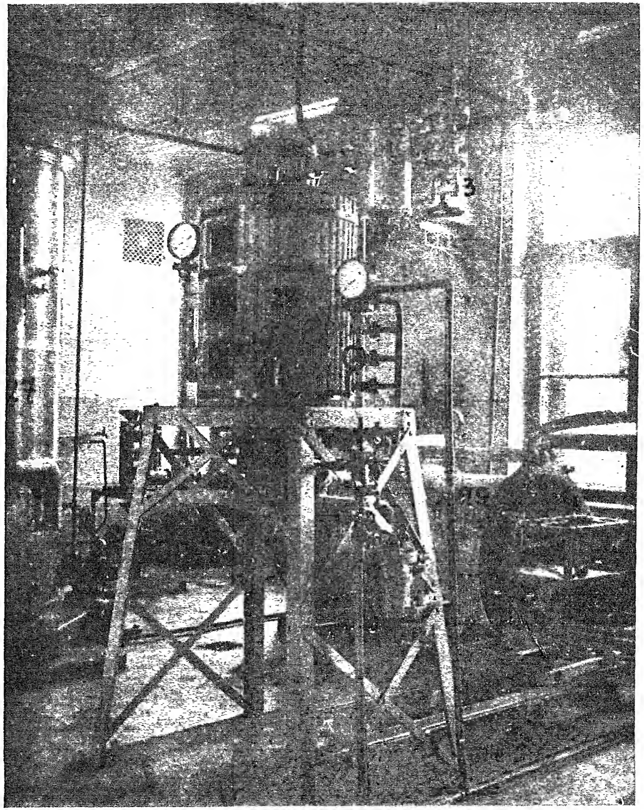


FIG. 116. — Experimental Station: 28) Steam boiler at pressure of 6 atmospheres — 29) Vacuum pump for refining — 30) Receptable Pasburg system.

PLATE XXXVI

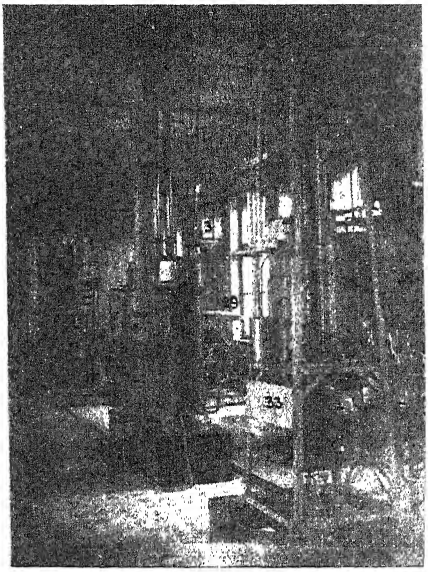


FIG. 117. — Experimental Station: 31) Wort rectifying column — 32) Refrigerator — 33) 2 Fermentation Vats — 34) Rectifying Column BARBET.

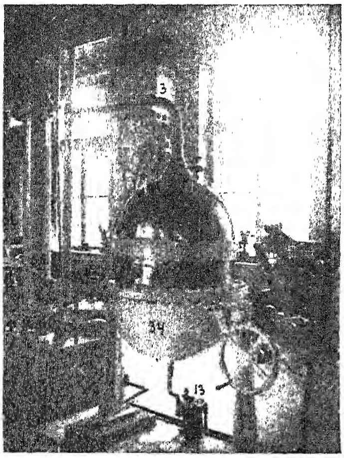


FIG. 118. — Experimental Station: 35) Vacuum pump for boiling potato wort — 36. Condenser.

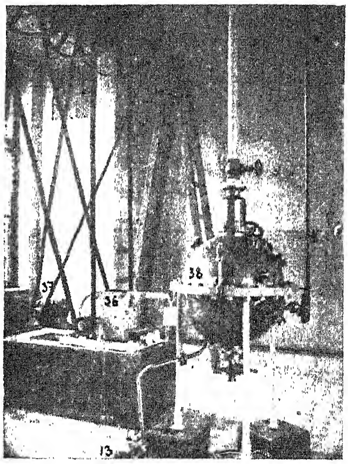


FIG. 119. — Experimental Station: 37) Potato rasp — 38) Motor 39. Vacuum pump.

Despite the very bad economic situation in the country, the idea was sympathetically received and it was decided to start the work necessary for its materialisation.

Towards the end of 1919 designs were drawn up for the equipment primarily of an experimental Station for the sugar industry. The making of the apparatus was entrusted to the work shops of the sugar factories. The end of 1920 saw the completion of the greater part of the equipment, and consequently the opening of the experimental Station for the sugar industry took place at Koursk early in 1921.

At a joint conference of the Union of sugar workers and of the Directors of the Sugar Industry held at Kieff in November 1921 it was decided on my advice to found an experimental station at Kieff, which should be the central station in all Russia for the sugar industry. Thereupon the whole of Koursk station equipment was sent back to Kieff to be under the agricultural Technology department of the Polytechnic Institute there and a certain amount of extra equipment was ordered. The Polytechnic Institute allotted enough room in its chemical laboratory for the provisional installation of this equipment, until such time as a special building should have been put up for the station.

Now the Agricultural Technology department of the Polytechnic Institute of Kieff already possessed the equipment of an experimental Station for industrial fermentation products, and hence it was decided to extend slightly the original project for the organisation of a research station dealing only with the sugar industry and to create instead a scientific research institute for dealing with the technology of every agricultural industry, which should cover all scientific experimental research on the sugar industry, the production of alcohol, beer, starch, molasses, vinegar, etc.

The equipment of this research institute is now complete and some idea of its arrangements can be got from looking at the reproductions given here of 17 photographs.

Among the machines will be seen wonderfully made models of those used in the factories, of which some are of recent invention and have been first tried at the experimental station. The Station is run exclusively by electricity and uses a special generating installation. It is furnished with very excellent measuring apparatus which allow of a minute control of operations and of the utilisation of energy.

The creation of the scientific Institute of Agricultural Technology is of enormous importance to the Ukraine and to the whole of the U.S.S.R. Firstly this Institute will allow the study under conditions similar to those found in practice of many questions theoretical and practical of agricultural Chemistry and other branches, which have not hitherto been studied and whose study in actual practice was often impossible for technical and economic reasons.

Again the Institute will act as the centre of study for trying out new type industrial machinery and new processes of production before their trial on a larger scale in actual practice.

Finally it will serve as the focus of all the living forces of the country, which are devoted to the perfecting of agricultural technology, by the concentration of all the scientific work and thought on this subject and by bringing the results of this work to the door of all interested.

The Institute will also be of great international importance. Its staff will endeavour to make the results of their work known to the whole world, as has been the traditional custom of Russian savants. My firm conviction of its importance to international science has induced me to write of its origin and equipment to the scientists of the world. At the same time I take this opportunity of asking similar institutions in other countries to help towards the development and perfecting of our Institute by sending us scientific material, models for the museum, publications for the library etc. The Institute will be quick to acknowledge all such help and will consider it a pleasant duty to give in exchange its own productions as well as by publication to spread widely the result of its scientific researches.

I. A. KOUCHARENKO.

INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

CELLULOSE AND ITS DECOMPOSITION IN THE SOIL BY MICRO-ORGANISMS.

The literature on the decomposition of cellulose in nature is growing daily, owing to the fact that this substance or group of substances forms the largest single constituent of plant tissues introduced in great abundance into the soil, in the form of animal manures, green manures and various plant residues. Notwithstanding the numerous contributions to the subject, we still know comparatively little concerning the organisms active in the decomposition of cellulose and the chemical processes involved. Since most investigators of soil organisms were looking for bacteria active in the particular processes under examination, and since the bacteria decomposing cellulose are rather specific in nature, the difficulties are easily understood. The question of direct or indirect participation of celluloses in the formation of dark-coloured organic residues in the soil has also called forth recently considerable discussion, especially from the point of view of the origin of peat and coal. The following paper is a summary of the investigations on the decomposition of celluloses by micro-organisms carried out at the Department of Soil Chemistry and Bacteriology of the New Jersey Station by the author and his associates.

MICROORGANISMS CONCERNED IN CELLULOSE DECOMPOSITION IN THE SOIL.

Micro-organisms capable of decomposing celluloses in the soil are found among bacteria, fungi, and actinomyces. The ability

of protozoa and other invertebrate animals to decompose cellulose in the soil still remains to be investigated.

Various attempts have been made to classify the cellulose decomposing bacteria into aerobic and anaerobic forms, thermophilic and denitrifying forms, but it is doubtful whether any sharp lines of demarcation can be drawn between the different groups, since a thermophilic form may be at the same time an anaerobic organism or may be capable of reducing nitrates to atmospheric nitrogen. If any division is to be made among the bacteria decomposing celluloses, it should not go further than the separation into the aerobic and anaerobic species and even here the division is not very sharp. Each of these two grou s may of course contain thermophilic and non thermophilic forms, organisms capable of bringing about the complete reduction of nitrates and those that are unable to do so. The group of aerobic bacteria includes a number of species capable of decomposing pure celluloses with a varying degree of rapidity; here belong spore-forming and non-spore forming bacteria, rod-shaped forms, spherical and spirochaete-like forms.

Very few of the anaerobic bacteria capable of decomposing celluloses have been so far isolated in pure cultures, so that it is impossible to say at present whether these represent various forms or only limited groups of organisms.

It is not a difficult matter to demonstrate the presence of aerobic bacteria in the soil capable of decomposing celluloses, isolate them and even count them or obtain approximate information as to their abundance in a given soil. For the study of the various organisms isolated by KELLERMANN and his associates (8,9), cellulose-agar can be used. A number of organisms can be thus isolated which form a range of varieties, as demonstrated by a study of their cultural characteristics and morphology, but which can be included into two or three groups or species. These organisms decompose cellulose only to a limited extent and can grow readily on media containing other sources of carbon than cellulose. However, the soil harbors various cellulose-decomposing aerobic bacteria, which prefer cellulose as a source of energy and which cannot even grow with any other carbon source. Ordinary agar media are unsuitable for the study and isolation of these organisms. Silica gel media containing cellulose as the only source of carbon and inorganic sources of nitrogen and minerals are very suitable for the study of these organisms (2, 16). Pure ground cellulose is suspended in a solution containing the ne-

cessary minerals in the proper concentration. The mixture is poured over the surface of a dialyzed silica gel plate and the excess of moisture is removed by drying the plate at 55°-60°C. The plates are inoculated with particles of soil and incubated at 28°-30°C. Growth will take place in the form of yellow or orange spots, within 2 to 4 days, around the soil particles. By diluting the soil with various volumes of sterile water, then adding some of the final dilutions to a series of plates, the approximate number of these bacteria can be determined.

Anaerobic bacteria capable of decomposing cellulose are present in the soil only to a very limited extent. This can be demonstrated by adding paper to the soil and introducing enough water to saturate the soil; the decomposition of the cellulose will proceed in a normal soil saturated with water at first very slowly. This is due to the fact that the fungi and aerobic bacteria (as well as the actinomyces), which are very active in the decomposition of cellulose under aerobic conditions in normal soils are prevented from attacking the cellulose, while no extensive flora exists in normal soils which would decompose celluloses, when the soil is covered with water. This flora, consisting of anaerobic bacteria has only to be developed. Decomposition of cellulose under anaerobic conditions will take place only after a month or more has elapsed. But once decomposition sets in, it proceeds very rapidly. When cellulose is again added to such an active soil, decomposition sets in immediately. Decomposition of cellulose under anerobic conditions is carried out largely by spore-forming bacteria, with the formation of acids and gases (10).

When cellulose, in the form of ground filter paper, is added to the soil and the resulting increase in the development of micro-organisms is determined by the ordinary plate method (14), it is found that bacteria and fungi developing on the plate are both stimulated, but to a different extent, depending upon the soil conditions (17,18). As shown in Table I the addition of nitrogen to a soil receiving a heavy application of cellulose brings about a decided increase in the rapidity of cellulose decomposition. This is accompanied by a decided increase in the number of fungi and bacteria. Nearly all the fungi decomposing cellulose in the soil are capable of developing on the agar plate and, in spite of the various limitations of the plate method for determining the abundance of fungi in the soil, the results thus obtained can still serve as an index of the development of fungi due to the addition of cellulose to the soil. However, the increase in the numbers of bacteria resulting from the addition of

TABLE I. — *Influence of 1 per cent. cellulose, with and without $NaNO_3$ upon the development of micro-organisms in the soil after 17 days.*

Soil	Soil reaction	$NaNO_3$ added	Fungi		Bacteria (including Actinomyces)	
			Start	End	Start	End
	pH	per cent.				
Unlimed and manured soil.	5.4	0	87,300	320,000	6,500,000	21,400,000
		0.1	87,300	3,100,000	6,500,000	40,600,000
Limed and unmanured soil	6.5	0	20,000	47,000	7,760,000	17,400,000
		0.1	20,000	290,000	7,760,000	47,200,000

cellulose to the soil, as determined by the plate method, is not due necessarily to an actual increase in the cellulose decomposing bacteria, since these do not develop at all or only to a very limited extent on the ordinary synthetic medium used for counting soil bacteria. The increase in the cellulose decomposing bacteria has to be followed by special methods. The bacteria developing on the ordinary plate, as a result of cellulose decomposition, are secondary organisms which either decompose the products formed from the cellulose by the fungi and the cellulose-decomposing bacteria or which utilize as sources of energy the cells of these organisms themselves.

Table II shows that the addition of an excess of water greatly represses the presence of fungi in the soil as well as of bacteria developing on synthetic media under aerobic conditions. A direct determina-

TABLE II. — *Decomposition of celluloses and the development of bacteria and fungi in the soil, in 26 days.*

Cellulose added	$NaNO_2$ added	Moisture content (on basis of waterholding capacity)	Fungi		Bacteria and actinomyces	Cellulose decomposed
			Plate method	Microscopic method (*)		
per cent	per cent	per cent				per cent
0	0	50	54,400	1	8,000,000	—
0	0	100	18,000	0	800,000	—
0	0.1	50	62,000	1	8,200,000	—
0	0.1	100	24,700	0	2,100,000	—
1	0	50	120,000	3	16,800,000	20.8
1	0	100	20,000	0	1,000,000	33.1
1	0.1	50	340,000	4	71,000,000	84.2
1	0.1	100	20,200	0	17,300,000	20.6

(*) The figures indicate the relative abundance of fungus mycelium, as demonstrated microscopically.

tion of the abundance of *fungus mycelium* using the microscopic method, and staining the soil with methylene blue (6, 17) reveals a marked parallelism between the numbers of fungi as determined by the plate method and the relative abundance of the mycelium as indicated by the microscopic method. The addition of nitrogen to the soil greatly hastened the decomposition of cellulose under aerobic conditions, where fungi and aerobic bacteria are active, but not under anaerobic conditions, where anaerobic bacteria are entirely concerned in the process.

Various experiments established the fact that in humid acid soils fungi are largely responsible for the decomposition of celluloses. Whenever the fungi are eliminated cellulose decomposition comes to a standstill. The elimination of the fungi can be accomplished by treating the soil with volatile antiseptics or heating to 65°-75° for 1 hour. When partially sterilized soil is inoculated with fresh soil, cellulose decomposition takes place very rapidly, even more so than in untreated soil; this is accompanied by an extensive development of the fungi, as can be demonstrated both microscopically and by the plate methods (17).

The fungi decomposing celluloses are represented in the soil by a number of genera, including *Aspergillus*, *Penicillium*, *Trichoderma*, *Fusarium*, *Verticillium*, *Cephalosporium*, *Humicola* and others. The *Phycomycetes* do not decompose true celluloses. The type of fungi developing in the soil as a result of the addition of celluloses depends on the reaction of the soil, moisture content, and the nature of the available nitrogen.

The actinomyces capable of decomposing celluloses are represented in the soil by several species. Owing to the fact that these organisms do not grow at a greater acidity than pH 5.0 and owing to their slow growth, they are active in this process only to a limited extent and under certain conditions (17).

Nature of cellulose decomposition by micro-organisms. — The process of cellulose decomposition can be followed either by measuring the disappearance of the original cellulose added to the soil or by the evolution of CO_2 in the soil receiving the cellulose in excess of that evolved by the soil not receiving any cellulose.

By extracting the cellulose from the soil with SCHWEIZER's reagent and precipitating the extract with hydrochloric acid and washing, the amount of cellulose left in the soil undecomposed can be determined (3). A definite amount of cellulose, in the form of

ground filter paper, is added to the soil and, after various periods of incubation, the soil is analysed for residual cellulose. The amount of cellulose decomposed is found to depend on the moisture content of the soil, reaction and aeration, which determine the type of organisms participating in the decomposition processes, and upon the period of incubation and the amount of available nutrients, especially nitrogen, which modify the quantity of cellulose decomposed under a given set of conditions. The controlling influence of the available nitrogen upon the amount of cellulose decomposed is readily understood when one keeps in mind the fact that the micro-organisms synthesize a definite quantity of cell substance for every unit of cellulose decomposed; the greater the amount of cellulose decomposed the greater is the quantity of cell substance synthesized and, since this cell substance is more or less definite in composition, the greater will be the amount of nitrogen and minerals required. A definite ratio has been found to exist between the cellulose decomposed and the nitrogen transformed by the micro-organisms from an inorganic to an organic form, this ratio being about 30-35 to 1, *i. e.* for every 30 to 35 parts of cellulose decomposed in the soil by micro-organisms 1 part of soluble nitrogen is required. Since the available nitrogen is present in the soil only in limited amounts, the rapidity of cellulose decomposition will be controlled in ordinary soil by the rapidity with which the nitrogen is made available (15). Of course when the period of incubation is prolonged, the ratio will become wider and wider, since the synthesized cells of the micro-organisms will be in their turn decomposed and a part of the nitrogen will again be made available and will be utilized for a further decomposition of more cellulose. This is also the reason why in soils of different fertility cellulose will be decomposed at different rates, since the more fertile the soil the more rapid and abundant is the liberation of the nitrogen and minerals in an available form (Table III).

The ideas of CHRISTENSEN (4) that the ability of the soil to decompose cellulose can serve as an index of its fertility, of NIKLEWSKI (12) that the decomposition of cellulose in the soil is largely controlled by the presence of available nitrogen, of CHARPENTIER (3) and BARTHEL and BENGTSSON (1) that the favourable influence of manure upon cellulose decomposition is due to the presence of available nitrogen and not to the introduction or a new microflora are thus confirmed and explained. The more fertile a soil is, the

TABLE III. — *Influence of available nitrogen upon the decomposition of cellulose in soils of different fertility.*

$NaNO_3$ added to 100 gm. of soil	Cellulose decomposed (1 per cent added)	
	Unfertile soil, 6 weeks incubation	Fertile soil, 4 weeks incubation
mgm	per cent	per cent
0	36.9	42.2
25	41.7	66.7
100	59.7	97.2

greater will be the amount of nitrogen liberated in the form of ammonia and nitrate in a given period of time. Since the quantity of cellulose decomposed in a given soil is in direct relation to the available nitrogen, the more rapidly this nitrogen is liberated from the complex organic nitrogenous compounds of the soil the more rapidly will the cellulose be decomposed by the micro-organisms in the soil. This points to the futility of all the attempts made in the past to inoculate the soil with bacteria or other organisms which decompose the soil organic matter more actively than the native flora. A change in soil conditions as a result of treatment will bring about a corresponding change in the flora. The introduction of a supposedly "more vigorous flora" will prove of no consequence when the soil conditions are not favorable for this flora.

The decomposition of cellulose in the soil can also be followed by the course of evolution of CO_2. This method first suggested by NIKLEWSKI (12) has the advantage over the direct determination of residual cellulose in that the process can be followed uninterruptedly for any length of time. The amount of CO_2 produced from the control soil is of course subtracted from the CO_2 produced from the soil to which cellulose has been added, the assumption being that the decomposition of the soil organic matter is not influenced by the addition of cellulose.

The carbon liberated as CO_2 forms only a part of the cellulose decomposed. This is due to the fact that part of the carbon is stored away in the form of cell-substance or other synthesized materials, and part is left in the form of various intermediary substances or products of cell metabolism. The latter is especially abundant in the decomposition of cellulose under anaerobic conditions. The ratio of the carbon liberated as CO_2 to the carbon of the cellulose

decomposed will thus depend upon the nature of the organisms which bring about the decomposition of the cellulose. In well aerated soils where fungi and various aerobic bacteria are the most active agents in the process of cellulose decomposition, about 50 to 65 per cent. of the carbon of the cellulose may be liberated as CO_2, about 30 to 35 per cent. of the carbon utilized for the synthesis of cell substance, and only about 5 per cent. left in form of intermediary products. Under anaerobic conditions only about 20 per cent. of the carbon of the cellulose decomposed may be liberated as CO_2 and a small amount of it utilized for synthetic purposes, while a large part of the carbon is left in the form of organic acids or liberated as methane. The results in Table 4 show the ratio between the cellulose decompo-

TABLE IV. — *Decomposition of 1 per cent. cellulose by a pure culture of Tricoderma in sterile soil.*

Incubation	Cellulose decomposed	CO_2 produced (excess over control)	Nitrogen assimilated	Dry mycelium synthesized	Cellulose decomposed / Nitrogen assimilated	Economic coefficient	Respiration equivalent	Plastic equivalent
days	*mgm. C.*	*mgm. C.*	*mgm. N.*	*mgm.*			*per cent.*	*per cent.*
7	281.9	114.2	17.9	378.0	35.1	1.7	40	59
14	389.4	179.9	20.4	472.0	43.1	1.8	46	54
21	400.0	209.5	21.7	429.0	41.1	2.1	52	47

sition, nitrogen assimilation, synthesis of cell substance and CO_2 evolution by a pure culture of a fungus (*Trichoderma* sp.) grown in sterile soil to which a synthetic solution containing a definite amount of nitrogen and minerals has been added. The economic coefficient indicates the ratio $\frac{\text{cellulose decomposed}}{\text{dry mycelium synthesized}}$;

$$\text{respiration equivalent} = \frac{\text{carbon of } CO_2 \text{ liberated}}{\text{carbon of cellulose decomposed}}$$

$$\text{plastic equivalent} = \frac{\text{carbon of mycelium synthesized (6)}}{\text{carbon of cellulose decomposed.}}$$

Role of cellulose in the formation of "humus" in the soil. — The literature of soil science is full of statements concerning celluloses as the mother substances of soil "humus". Even among the most

recent contributions to the origin of coal, various suggestions are made as to the probable processes whereby cellulose is converted into "humus" then into coal (11). Some claim that celluloses give rise to dark coloured substances, similar to the formation of dark bodies when sugars are boiled with acids or alkalies. Others claim on the other hand, that celluloses are decomposed completely without leaving any residual materials and they cannot serve, therefore, as the mother substances of "humus". Unfortunately most of these claims are not based on experimental evidence, but are pure and simple speculations.

As a result of numerous experiments on the decomposition of cellulose, under aerobic and anaerobic conditions by bacteria, fungi and actinomyces in pure and mixed cultures, it can be stated definitely that celluloses do not contribute directly to the soil organic matter or "humus". Celluloses are, next to the sugars and starches, among the most readily decomposable constituents of the plant material commonly added to the soil. All soils harbor numerous organisms capable of attacking celluloses. These will be decomposed under aerobic or anaerobic conditions completely; in the first case to CO_2 and water, in the second case with the formation of various organic acids and gases. No dark coloured substances are ever formed from pure celluloses. Practically 100 per cent. of the carbon of the cellulose decomposed can be accounted for by the cell substance synthesized and by the intermediate and final products formed including the CO_2.

Indirectly however celluloses do contribute to the accumulation of organic matter in the soil ("humus") which is more or less resistant to decomposition. As pointed out above a part of the carbon of the cellulose, amounting to as much as 30 to 40 per cent. in the case of fungi, is utilized by the organisms for the synthesis of cell material. This newly synthesized substance can again undergo decomposition, but not completely; only a certain part of this cell substance is readily decomposed by other organisms. A certain part amounting to 20 per cent. or more of the synthesized cell substance is resistant to decomposition and possesses all the properties which are characteristic of the soil "humus". A detailed study of the origin of "humus" in the soil, from the point of view of microbiological processes, is now in course of publication.

Summary.

1. In normal aerated soils, celluloses are decomposed largely by fungi, certain aerobic bacteria and to a lesser extent by *actinomyces*.

2. Anaerobic bacteria capable of decomposing celluloses are present in normal soils only to a very limited extent but are found abundantly in bog soils.

3. The aerobic bacteria capable of decomposing celluloses are represented in the soil by a number of groups, some of which are very active while others bring about only a disintegration of cellulose fibres. Some of these bacteria, especially the active forms, cannot use any other source of carbon but celluloses.

4. The fungi are represented in the soil by a large number of species capable of decomposing true cellulose. The *Phycomycetes* are unable to carry out this process.

5. Among the numerous actinomyces found in the soil, only a few species are capable of decomposing celluloses actively.

6. The type of organisms taking an active part in the decomposition of cellulose added to a given soil will depend upon the nature of the soil, its reaction, moisture content and presence of available nutrients. A special set of conditions will favour the development of certain organisms, which bring about the decomposition of celluloses in preference to others.

7. The decomposition of cellulose in the soil can be measured quantitatively either by the disappearance of the cellulose or by the evolution of CO_2, especially under aerobic conditions.

8. Celluloses are decomposed completely by micro-organisms in the soil; under aerobic conditions, part of the carbon of the cellulose decomposed (50 to 65 per cent.) is liberated as CO_2, part of the carbon (25-35 per cent.) is utilized by the organisms for the synthesis of cell substance and only a small part (5-10 per cent.) is left in the form of intermediary products. Under anaerobic conditions, a much smaller part of the carbon of the cellulose decomposed is liberated as CO_2 and is assimilated by the organisms, while a considerably greater part is left in the form of various intermediary products largely organic acids.

9. There is a definite ratio between the amount of cellulose decomposed and the nitrogen required by the organisms for the synthesis of cell substance. This ratio is usually 30 to 35 in the case of fungi. It becomes wider in the soil, with a mixed flora, and with continued incubation, especially in the absence of an excess of nitrogen, due to the constant liberation of more nitrogen from the soil organic matter and especially from the cell substance previously synthesized.

10. Directly cellulose does not contribute to the formation of "humus" in the soil. Indirectly, namely through the cells of the micro-organisms, it does. Since a certain part of the carbon of the cellulose decomposed is reassimilated by the organism for the synthesis of cell substance, and since a part of this synthesized material is resistant to further rapid decomposition, a part of this material will become an ingredient of the soil "humus".

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PREPARATION OF A SOIL FOR PRACTICAL SUSPENSION ANALYSIS

To enable us to get the most exact values for the final physical composition of a soil, the different suspension apparatus in use have been considerably improved in recent years. But not to lose anything from this increase in precision, one has to take all the care possible to eliminate every possible source of error from the *preliminary preparations* of the soil for suspension analysis. It is this preliminary preparation of the soil, by the methods now in use, that leaves much to be desired. The procedure proposed by the standardisation section for amelioration in 1924 was as follows: the fine soil, of below 2 mms., is soaked during the night and then boiled for an hour. The soil so treated is then thoroughly pounded several times, with constant changing of water, until the water shows no turbidity: only then starts the real suspension method (1). It is quite evident that this energetic rubbing may according to the character of the soil introduce considerable errors, e. g., the small part-weathered fragments of stone, which would have kept their same composition undisturbed in the soil for many years, are often crushed to atoms by this pounding. And the same applies to silt particles and still finer material. In this way the final composition of the resulting material is quite unlike that of the original soil sample, being finer and much richer in clay. And this difference will be the more pronounced the richer the soil originally was in weathering material, the more closely it approached in character a definite type of soil, and the softer the original material was. If the soil particles are unaffected by prolonged soaking and boiling, it can be assumed that under the influence of the slow prolonged weathering in the soil they will keep their original composition for long enough to give the soil definite physical characteristics which are not the

(1) The preparation of the soil by simple shaking without warming has, so far, not yet been generally accepted, and hence it is impossible to take up a critical attitude with regard to it.

same as those produced by the same particles energetically pounded to bits. It is therefore not a criterion of purity of a given particle determination that after suspension nothing further can be rubbed off (especially if the products of suspension have been dried on the water-bath or in the hot-air oven, i. e. at a high temperature !). To decide properly the question of purity the microscope must be used.

Boiling has this advantage that the constant agitation keeps the particle in an uninterrupted whirling motion, and this motion by rubbing the particles *gently* against each other rubs off the adhering clayey coating, without, hurting its physical constituents as does the *energetic* rubbing. But the disadvantage of boiling is that, despite the uniform warming of the water and soil, tension is set up, which may cause a disintegration of the different small stones or stone particles present, and this the more readily, the nearer the given soil sample originally was to the weathering zone. This also leads to errors varying with the character of the minerals in the soil. Boiling of a soil sample is also inadvisable because of the danger of coagulation of the smallest particles when the " suspension residues " have to be still further separated into their different sized particles.

Thus boiling or strong rubbing are very similar in their action to the boiling of a soil sample with concentrated hydrochloric acid, as in chemical soil analysis, since, in both cases we are doing something rarely accomplished by weathering.

The best method of preparation of soil samples for analysis would therefore be one, possessing all the advantages of the boiling method without the sources of error introduced by heating i. e. a kind of " cold heating ". By placing some soil soaking in water in a vessel attached to an air pump and drawing for an hour a current of air from below through the soil-water mixture, so as to keep the mass in an agitated condition, the author believes he has got very near to our " cold boiling ". The Kopecky method of suspension analysis, using 25 gms. of soil, as employed in most laboratories, makes it possible to use for the above preparation of the sample the usual laboratory water-pump, unless indeed we are dealing with an extraordinarily coarse soil, in which case the sample must be divided up. The " cold boiling " is the more vigorous and the current of air passing through the mixture is greater, the smaller the difference between the diameters of the mouth of the pump and that of the glass vessel. In addition the glass vessel must be capable of holding enough water to enable a

PLATE XXXVII

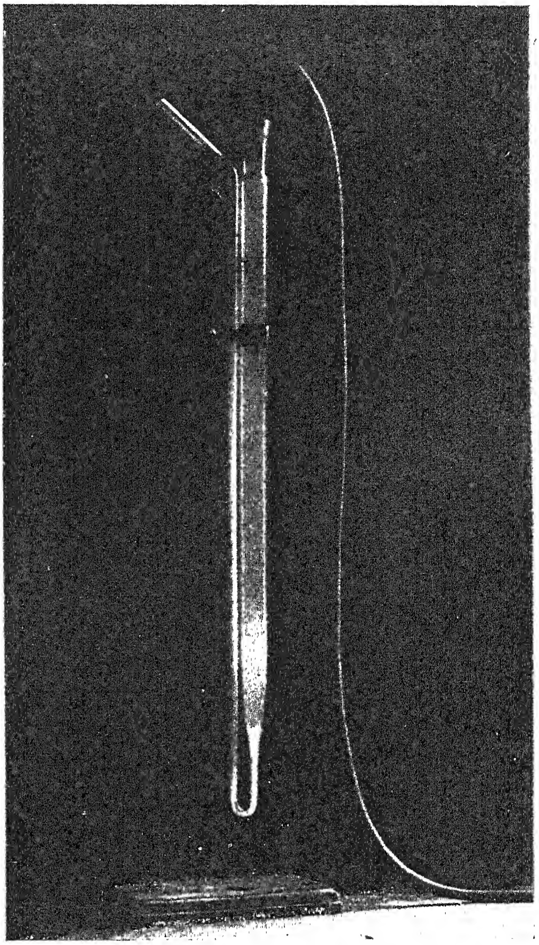

FIG. 120. — Kopecky's Coarse Sand cylinder for "cold boiling" soil samples.

proper agitation of the earth to be kept up, and there must be space enough above the column of water to make it impossible for anything from the water-soil mixture to be carried away by the air current. From among all the different vessels present in every soil science laboratory, the coarse-sand cylinder of KOPECKY seems the best for the carrying out of the " cold boiling ". The illustration shows the arrangement of the apparatus.

The far-end side piece, after it has been half filled with the soil-sample and water for soaking, is attached by means of a rubber cork and a piece of ordinary tubing to the water pump (pressure tubing must not be used, to prevent the production of an excessive pressure and the smashing of the glass vessel). Through the narrow, open end, a constant current of air is drawn from below through the column of water, at such a rate, that about 150 agitations are produced in the mixture in a minute. Certain rules and precautions will occur to any one who has experience in suspension analysis e. g. that the narrow, open end, shall, when filling, be closed by a piece of rubber tubing and a pinch cock, and opened only *after* the pump has started working, so as to prevent sucking back and choking of the narrow end by earth, or that water can be added to the open end when the earth shows a tendency to stick in the bend. This method of preparing soil samples for analysis has also this advantage that the apparatus can be left working for any desired length of time, without having to add water or pay any further attention to it.

The correct procedure is then as follows: the fine soil is soaked in water and after a time the larger lumps are crushed with the fingers, so as to allow a better penetration of the water. After soaking for several hours, preferably the whole night, the soil sample is then treated for an hour with the air-pump, after which the suspension analysis is proceeded with in the usual prescribed manner.

Although it is intended to deal with the preparations for suspension analysis of the different, separate types of soil e. g. the special treatment required by humus soils, in a later and special paper, yet, I would point out now in a number of soils the differences produced in the KOPECKY suspension analysis by the different ways of preparation treatment. In the work described in the table given, carried out by the author in collaboration with Dr. HENKEL, examples are given not only of samples treated by the air pump method but also of those treated by the boiling method but without excessive pounding, so that differences in results can be attributed solely to the

application of heat. The results prove that the different soil-samples have behaved very differently. While some underwent very little change on heating others suffered considerable disintegration.

Differences in the results of Kopecky's suspension analysis due to differences in preliminary treatment.

Soil	Preliminary treatment	Coarse sand	Fine sand	Silt	Cyla
		%	%	%	%
Alluvial sandy moor soils	boiled	65	4	7	24
	air pump	72	16	2	10
Jurassic sandy soils	boiled	8	59	13	20
	air-pump	9	60	14	17
Marshy sandy soils	boiled	19	21	31	29
	air-pump	19	22	34	25
New Red Sandstone soils	boiled	34	58	1	7
	air-pump	33	59	2	6
Oberrortliegendes Sandy loamy soils	boiled	20	22	20	38
	air-pump	21	23	17	39
Lettenkohl loamy soils	boiled	20	16	10	54
	air-pump	28	15	9	48
Loess loamy undersoil	boiled	11	10	27	52
	air-pump	12	10	51	37
Keuper, clayey soil	boiled	8	12	26	54
	air-pump	9	19	32	42
Alluvial clayey loamy soils I.	boiled	24	14	17	45
	air-pump	28	19	11	42
Subsoil of above	boiled	15	19	11	55
	air-pump	21	29	18	32
Alluvial clayey loamy soils II.	boiled	6	20	17	57
	air-pump	13	28	22	37
do III	boiled	17	12	20	51
	air-pump	29	18	21	32
do IV	boiled	23	12	13	52
	air-pump	30	14	13	43
Clayey soils of the upper shell limestone	boiled	6	6	26	62
	air-pump	5	5	7	83
Clayey soil of the lower gypsum Keuper	boiled	8	10	20	62
	air-pump	7	11	26	56
Clayey soils of the lower Rotliegenden	boiled	12	13	18	57
	air-pump	13	13	22	52
Keuper Fireclay	boiled	34	58	1	7
	air-pump	33	59	2	6

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BACTERIOLOGICAL METHODS FOR THE INVESTIGATION OF SOIL FERTILITY.

During the infancy and early stages of soil bacteriology in the later decades of the nineteenth century, great expectations were aroused as to the information that this science might give on the conditions of soil fertility. However as these expectations were subject to some disappointment, the whole question is now made the object of more sober consideration. Still we must not infer that scientific research has lost interest in that branch of soil science — on the contrary — all over the world, the numerous and important problems which soil bacteriology presents, are being made the subject of careful study, especially those dealing with the relation of soil microorganisms to the chemical and physical factors governing soil fertility.

Two main directions are followed: 1) Floristic research (qualitative and quantitative studies on the composition of the soil's microflora), and 2) Physiological research (studies on the changes in soil matter).

1. Floristic Research.

The determination of the soil content of microorganisms — the basis of all study along this line in the early days of soil bacteriology — was almost completely abandoned after 1902, when Remy introduced experiments in quantitative decomposition. However of late the former method has been largely resumed, not only as an auxiliary but also as a comparatively independent method for studying soil fertility. It was with this method that Hiltner and Stoermer (1903) and Russell and Hutchinson (1909-12) made their fundamental studies on partial sterilization of soil, while a number of other investigators — Fabricius and Feilitzen (1905), Egberding (1909), Temple (1911), Fisher (1909-1911), Bear (1917) — to name only a few — have used it for the study of the influence of lime, stable manure etc. on the microflora of the soil. Later H. J. Conn (1910-22) developed

the counting method to a very considerable degree and combined the plate counting method (using synthetic media of a well defined chemical composition) with a method for direct microscopic counting of micro-organisms, in soil suspensions. Even though the results of these two methods are far from identical (the direct counting method gives 5-20 or even 40 times as high figures as the plate counts, a result partially confirmed by WHITTLES (1923) and WINOGRADSKY (1925), the results were constantly found to run parallel when different soils were compared or when the number of microorganisms was increased by adding stable manure or other organic matter to the soil. The determination of the number of bacteria thus becomes, if not a picture of the total soil flora, at least an index of the bacteriological condition of the soil. CONN has chiefly used his methods for the study of the composition of the soil micro-flora, the seasonal variations in the numbers of bacteria and the relative importance of various groups of soil bacteria in the transformation processes in the soil. Quite recently the plate method has been further developed in England by THORNTON (1922), and FISHER, THORNTON and MACKENZIE (1922), and in the United States by LIPMAN and BROWN (1910), FRED and WAKSMAN (1922), WAKSMAN 1922 *a* and 1922 *b*. These studies show among other matters, that apart from the effect of less suitable media of an undefined and irreproducible composition the negative results so often obtained by earlier investigators must be largely due to the following facts : The number of bacteria in a given soil is, even under constant external conditions far from constant ; in the first place it may show remarkably large " rhythmical " fluctuations, often within periods of a few hours (THORNTON 1923) and secondly it varies inversely to the number of active protozoa and especially amoebae in the soil (CUTLER, CRUMP and SANDON 1922). Furthermore as the number of bacteria in a seemingly uniform soil plot varies greatly within closely adjacent localities, in making investigations so many duplicate samples, each a composite of several individual samples, should be taken that the variability in bacterial numbers can be determined and a reliable account made for the experimental error (FISHER, THORNTON and MACKENZIE, 1922, WAKSMAN, 1922). Finally not only should the numbers of bacteria be considered but attention should also be given to the other groups of heterotrophic soil organisms, especially actinomycetes and fungi. (WAKSMAN, 1922). When these points are duly taken into consideration in connection with fertilising experiments in the field, it is possible, as shown by WAKSMAN (1922) the most thor-

ough student of the problem, to obtain results which show a distinct correlation between crop producing power and number of bacteria and actinomycetes in the soil. WAKSMAN (1921) has also worked out a special method for making quantitative determination of the number of fungi in the soil. The number of micro-organisms and especially the ratio of fungi to bacteria and actinomycetes may not only be determined by the amount of plant nourishment in the soil, but is also to a marked degree influenced by the reaction of the soil, the fungi predominating in acid, and bacteria and actinomycetes in neutral and alkaline soils. Our own investigations on a number of Danish soils have fully confirmed these facts. In another paper WAKSMAN (1917) has shown that fertile soils harbour greater numbers of fungi both as regards species and individuals than do poor soils. The fungous flora shows a certain relationship to soil character, soils from warm and dry regions being very rich in *Aspergilli*, whereas the *Mucorales* and *Penicillia* are the predominant forms in soils from colder climates, and the *Trichodermae* are specially numerous in strongly acid and water-logged soils. This has been found to a certain extent to hold good for Danish soils. The actinomycetes too show some relation to soil conditions, their relative number being high in neutral and alkaline soils, but in soils with a pH value below 5.0 both their relative and absolute number are very markedly reduced. This, however, has not been confirmed by the Danish soils. Later on WAKSMAN and STARKEY (1924) in a very interesting paper have shown that the micro-flora of soils of different fertility is differently affected by the addition of nutrients, and that the different effects show a correlation with the deficiency in plant food. Among more occasional observations on the positive correlation between bacterial numbers and crop-producing power mention should be made of the work of NOYES and CONNER (1919) and NELLER (1920).

Note should be made in this connection of the fact that S. WINOGRADSKY (1925) has quite recently worked out new refined methods for direct microscopic analysis of the microflora of the soil. The preliminary results reveal very striking differences between soils of different characters and further reports are awaited with much interest.

2. PHYSIOLOGICAL RESEARCH.

For an account of the physiological research work in soil fertility reference should be made to the report of HARALD R. CHRISTENSEN

delivered before the IV International Conference on Soil Science in Rome, 1924, in which is a detailed description of the "principle of inoculation" introduced by the author. This principle, based on microbiological matter transformation experiments, aims directly at estimating the influence exerted both by the actual microbiological and the chemical condition of the soil on the course of transformation in soil matter.

CHRISTENSEN'S studies, in which the principle of inoculation was used, dealt specially with mannite, cellulose, and peptone decomposition, and it was found that the course of these transformations under the given conditions is to a particular degree governed by the reaction condition and the supply of easily soluble phosphoric acid compounds. The principle seems to allow a microbiological determination of these and possibly also of other soil characteristics.

Since then other investigations have been made along these or similar lines. The following deserve mention:

a) *Mannite decomposition.*

WAKSMAN and KARUNAKAR (1924) found, in agreement with CHRISTENSEN (1922), that the addition of phosphates exerts a markedly beneficial influence upon mannite decomposition in acid and somewhat infertile soils (from unfertilised plots and plots constantly treated with physiologically acid fertilisers), while it was without any effect in fertile, nearly neutral soils. The authors have further observed a complete correlation between the speed of mannite decomposition and the amount of crop yield in soils from 7 differently treated plots in a permanent fertilising experiment.

b) *Cellulose decomposition.*

The determination of the speed of cellulose decomposition as an index of the supply of plant food in the soil and measured by the carbon production seems to have been suggested for the first time by B. NIKLEWZKI (1912). Recently C. CHARPENTIER (1921) has worked out a method for quantitative determination of cellulose in the soil and this has led to renewed interest in the study of the relation of cellulose decomposition to soil conditions. By means of this method CHARPENTIER was able to show that a soil's content of certain nitro-

gen compounds in a particular degree governed the rate of cellulose decomposition. The addition especially of stable manure accelerated the process. BARTHEL and BENGTSSON (1923) state that when soil is mixed with 1 % Cellulose and various amounts of ammonium salts, the amount of cellulose decomposed within a certain time is almost proportional to the amount of nitrogen added. The effect of stable manure is nearly proportional to its content of ammonium nitrogen, whereas its bacterial content seems to have no significance. WAKSMAN and HEUKELIKIAN (1924) arrive at similar results. By addition of cellulose to the soil and determination of its rate of decomposition they attempt to obtain an index of the content of available, i. e. readily nitrifying nitrogen in the soil. When sodium nitrate is also added, an index of the phosphorus compounds available for the cellulose decomposing micro-organisms is obtained. STARKEY (1924) using CO_2 production for measuring the decomposition rate, observes that cellulose and organic substances rich in cellulose, such as rye straw, are decomposed more rapidly in fertile than in poor soils, and in agreement with WAKSMAN and HEUKELIKIAN he notes that addition of nitrates has a far more pronounced effect in fertile than in poor soils (in which phosphoric acid now becomes the limiting factor).

C) *Protein decomposition.*

The results of the numerous investigations made by CHRISTENSEN (1914), and described in his lecture at Rome in 1924, to which reference has already been made, tend to show upon the whole that a weak power of peptone decomposition under all circumstances indicates decidedly unfavourable soil conditions. Soil reaction was found in a special degree to govern the speed of peptone decomposition. Otherwise the various scientists who have studied the protein decomposing power of soils in relation to soil fertility have reached very dissimilar and contradictory results. Several scientists, e. g. FISHER (1911) and TEMPLE (1919) find no correlation ; BROWN (1916) on the other hand finds correlation and BURGESS (1918) finds differentiation only between very fertile and very poor soils. WAKSMAN (1923) who has studied the problem very extensively, is convinced that the degree of ammonia production in solution or soil cultures only affords very incomplete information concerning soil conditions, and that the process is a function of too many variable factors to serve as a useful index of soil fertility.

d) *Nitrification.*

In earlier investigations CHRISTENSEN (1914), using solution cultures in which the nitrifying power is primarily governed by the number of nitrifying organisms introduced with the soil, noted no, or only slight differences between the nitrifying power of the individdual soils. Sphagnum peat in which nitrifying organisms were not found is an exception. In further studies, not yet published, it has been found that the nitrification rate of ammonium salts is primarily determined by the ability of the soil to neutralize the acids formed by the process — in other words — by the buffer effect of the soil. An unquestionable correlation between nitrifying capacity and soil productivity has however been shown to exist in many of the numerous experiments chronicled in the literature on the subject: ASHBY (1907), LOEHNIS (1905), GUTZEIT (1906), VOGEL (1910), KELLERMANN and ALLEN (1911), GREAVES (1913), LIPMAN (1914), BROWN (1916), BURGESS (1918), NOYES and CONNER (1919), WAKSMAN (1923 b and c), and others. This may probably in the main be explained by the well-known fact that the reaction condition of the soil may affect soil fertility to a very considerable degree. It is therefore important to realize that a nitrification experiment will generally furnish no other information on soil conditions than that which could be obtained by a chemical determination of the buffer effect of the soil. It is interesting to note in this connection that the fine correlation found by WAKSMAN (1923 c) between nitrifying capacity and crop production of unlimed soils is less pronounced in the case of limed soils; in the latter instance it was found that liming greatly stimulated nitrification in somewhat infertile soils without markedly increasing the crop yield, BEAR (1917), and BARTHEL and BENGTSSON (1920) agreeing in their results that the course of nitrification is first and foremost determined by the reaction and buffer content of the soil. This is, however to a certain degree complicated by the fact that according to the results of GAARDER and HAGEM (1920-23) and MEEK and LIPMAN (1922) strains of nitrifying organisms exist which possess different pH optima and pH limits for growth. This may partly account for the vigorous nitrification known to take place in certain acid forest soils WEIS (1910 and 1924), C. OLSEN (1921). That the course of nitrification depends so little on factors other than the reaction condition is probably related to the fact established by MEYERHOF (1916-17)

that the mineral nutrient requirements of the nitrifying bacteria are very minute. This fact will probably render an attempt to obtain indications of the mineral nutrient supply in soils by means of nitrification experiments hopeless.

e) *Nitrogen fixation.*

The dependence of nitrogen fixing bacteria on the reaction condition of the soil has manifested itself clearly in a number of various investigations. Those applied to *Azotobacter* have led to the working out of the so-called Azotobacter-test for the determination of the lime requirement of soils, and applied to the nodule bacteria of leguminous plants has led to research work on the relation of various nodule bacteria to soil reaction (FRED and DAVENPORT (1917) on several nodule bacteria, STEVENS (1919) on lucerne and sweet clover bacteria, BRYAN (1922-23) on lucerne, clover, and soya bean bacteria, and WRIGHT (1925) on soya bean bacteria). These investigations are valuable for ascertaining whether a given soil, as indicated by its reaction, is adapted to the cultivation of the leguminous plants in question. GAINEY (1918-23), GAINEY and BATCHELOR (1923), CHRISTENSEN (1923), CHRISTENSEN and TOVBORG JENSEN (1924) and E. J. PETERSEN (1925) have shown that the critical limit of acidity for the development of *Azotobacter chroococum* lies at pH 5.8-6.0 In a quite recent paper GAINEY (1925) shows in agreement with earlier similar experiments of CHRISTENSEN (1914) that *Azotobacter* will soon die out if introduced into soils with acid reaction. WAKSMAN and KARUNAKAR (1914) using experiments with a number of soils of different fertility and mixed with 1 % mannite have found that no nitrogen fixation occurs in soils with pH value below 6.0, whereas it was more or less vigorous in soils having a higher pH value. The same authors, studying the nitrogen fixation in a 2 % mannite solution inoculated with 5 % soil obtained no correlation between the intensity of nitrogen fixation and soil productivity. Judging from these results nitrogen fixation seems in a high degree to be determined by *Azotobacter*, the presence of which undoubtedly indicates favourable soil conditions. Besides requiring definite reaction conditions, Azotobacter has a definite rigid need of available phosphoric acid compounds, a fact upon which CHRISTENSEN (1914) and recently NIKLAS and HIRSCHBERGER (1924) based a biological test for the determination of easily soluble phosphoric acid compounds in the soil. BEIJERINCK (1925) has recently

described a new Nitrogen fixing bacterium said to be rather characteristic of poor soils.

f) *Carbon dioxide production.*

The carbon dioxide producing power has often been suggested as an index of the total microbiological activity of the soil. Such determinations were first carried out by PETERSEN (1870) and WOLLNY (1897). Since then numerous scientists have dealt with the problem, though we can only mention here a few of the papers : STOKLASA and ERNEST (1905) considered the carbon dioxide production by soil bacteria to be of much importance in rendering phosphoric acid compounds available to higher plants. HESSELINK van SUCHTELEN (1910) noted that the carbon dioxide production reacted more readily to the addition of nutrients to the soil than did the bacterial numbers. LEMMERMANN, ASO, FISCHER and FRESENIUS (1911) who have carried out extensive studies on carbon dioxide production in the soil observed that this production from organic matters, such as vetch straw, horse manure, and green rye, was stimulated by small amounts of lime, while heavier doses sometimes had the contrary effect. STOKLASA (1912) found a positive correlation between bacterial numbers, carbon dioxide producing capacity, and soil productivity. NELLER (1920) found a more vigorous carbon dioxide production in limed than in unlimed soil. WAKSMAN and STARKEY (1924 a) distinguish between " respiratory power " (CO_2-evolution from the untreated soil) and decomposition power " (CO_2-evolution from soil + 0.5 % dextrose) ; they find the " respiratory power " correlated with bacterial numbers, the nitrifying power, and the crop producing power ; the same holds true, to a certain degree, of the " decomposing power ". However a soil treated with physiologically acid fertilisers behaved abnormally ; although its productivity was very poor and its respiratory power weak, it had a strong decomposing power because of the very active fungous flora, to which the treatment had given rise. Studies on the problem are at present being carried out at the State Laboratory of Plant Culture, Denmark.

g) *The carbon-nitrogen ratio in the soil.*

This has quite recently been made the object of some very noteworthy considerations by WAKSMAN (1924) who calls attention to the fact that the amount of nitrogen liberated as ammonia + nitrates

depends upon the quantity and quality of carbon compounds available as sources of energy, and the nature of the organisms which consume them. The fungi, which are gigantic organisms in comparison with the bacteria, have a more economic metabolism than the latter and synthesize large amounts of protoplasm; therefore when a certain amount of carbon food is consumed and transformed into microbial protoplasm and respiration products by fungi, far greater amounts of nitrogen are assimilated than is the case when the same amount of carbon food is consumed by bacteria. The actinomycetes stand midway between the two other group. An example taken from practical agriculture may be quoted: cellulose is, according to WAKSMAN and HEUKELIKIAN chiefly decomposed by fungi, especially in acid soils; this accounts for the unfavourable effect of straw manuring, undoubtedly due more to assimilation of soluble nitrogen than to denitrification.

These circumstances seem to explain a part of the function of lime in the soil; in acid soils, which harbour a great number of fungi in proportion to bacteria, large amounts of nitrogen are constantly kept assimilated as fungous mycelium — CONN (1922) has indeed by direct microscopical investigation found fungous mycelium especially abundant in acid soils containing much undecomposed organic matter —, because a relatively large amount of carbon food is constantly added in the form of plant residues poor in nitrogen. When such a soil is limed the bacteria and actinomycetes find a favourable reaction, and are enabled to compete with the fungi and carry out a relatively greater part of the soil metabolism. The decomposition of the organic nitrogen compounds now takes another course which results in liberation of more ammonia and nitrates than hitherto. A determination of the reaction condition of the soil and of the carbon-nitrogen ratio will therefore be of much value for the understanding of the course of microbial matter transformations in soil.

Speaking generally it is important to realize that the soil bacteriological investigations briefly sketched here have very considerably extended our knowledge of the soil micro-flora and the conditions of its development in directions favourable or unfavourable to agriculture. Particular stress should, as hitherto, be laid upon special studies of morphological and physiological character, although, with knowledge such as we have at present, it is premature to accept uniform, standardised bacteriological methods for estimating soil fertility. Regarding the question of a rational development of that part

of soil bacteriology concerning the influence of soil conditions on bacterial life and metabolism in the soil, attention should be called here to the vast importance of using methods already tested in connection with reliable vegetation experiments (pot or field experiments) and especially with permanent fertilising experiments, in which the estimation of crop development and the variations caused in the chemical condition of the soil furnish a reliable control of the influence of the factors in question upon plant growth. We shall then be able to judge of the value of the methods used for the study of soil fertility. We suggest therefore that such experiments be carried out in great numbers in the different countries of the world under various conditions of soil and climate. In the extensive bacteriological research work in connection with experiments of this kind, international co-operation in the form of interchange of soil samples, for instance, would be very desirable.

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Abstracts and Literature.

Soil Physics.

Temperature and Salinity.

Cotton Research Board, Fourth Annual Report 1923.

Part V of the report of the Cotton Research Board for the year 1923 states the researches prosecuted by Mr. MACKENZIE TAYLOR during that year on temperatures and on freeing the soil from salt. The writer studied the temperature of the soil during the fallow period, called the sharaqi period, and the effects of these temperatures from the point of view of the partial sterilization of the soil, which he considers as the principal benefit of the sharaqi period.

The observation of surface temperatures has enabled the sharaqi to be divided into three periods :

(*a*) a warming up period up till about 1st July, during which no partial sterilization is produced ;

(*b*) a period of high temperature, from the 1st July up to the 21st August which corresponds with an active partial sterilization ;

(*c*) a period of diminished temperatures, after the 21st August, corresponding with a decline of the partial sterilization.

Now since the introduction of perennial irrigation which allows of summer crops, the area of lands subjected to the sharaqi regime has been decreasing at the same time as the sharaqi, period has been becoming shorter consequent on the earlier planting of maize, which takes place in July at precisely the period when fallowing is most beneficial.

The experiments undertaken by the writer have shown that it would be profitable, in order to obtain subsequently higher yields of cotton, to postpone the sowing of maize until the 10th August. In studying the effects of summer fallow on the soil protozoa in Egypt, the writer remarked, that in spite of the partial sterilization which is produced during that period, the number of protozoa definitely remains constant. A change in condition however was experienced indicated by a decrease in activity.

The reclamation of soils containing chloride and carbonate of sodium was also the object of researches on the part of the writer.

It is known that this reclamation is at the present time based on the cultivation of rice, which is a summer crop and as such does not fully benefit by flood water.

The writer tried whether it was possible to eliminate the rice crop in order to save the water which is absorbed and to utilize that water, at flood, at a time when most was available, for washing the soil. The experiments made have shown that the elimination of chloride of sodium by simple washings is arrested at a given moment, that a hydrolysis of the sodium-clay complex, a deflocculation of the colloids is then produced ; the water no longer runs off in the drains and the soil becomes alkaline.

The growth of rice prevents these drawback. The rice is sown precisely,

in the course of the process of freeing the soil from salt, at the moment when, after preliminary washings, the hydrolysis of the sodium-clay complex begins to take place. The roots establish themselves in the surface layer of the soil; they generate carbon dioxide in sufficient quantity to transform the sodium hydrate formed by the process of hydrolysis, first of all into carbonate and then into bi-carbonate of sodium. This latter substance, not being alkaline, prevents the deflocculation of the soil colloids and hence the soil remains permeable. The successful growth of rice therefore plays a capital part in the reclamation of the soil. Unfortunately a successful rice crop cannot be guaranteed. Accordingly the writer has tried whether it is possible to do without it and to devise a method whereby the sodium clay complex might be hydrolysed and the alkaline products of this hydrolysis, due to the action of continuous washing of the soil, removed. Experiments to date point to the possible use of sodium bisulphate.

On the Effect of Drainage on the Physical Condition and the Mechanical Construction of Soil.

JANOTA RUDOLF, O účinků drenazé na fysikalni stov a mechanickon stavbu půdy. Sborník výzkummych ústavů zemědělskych, sv. 16. *Ministerstvo zemedelstvi*. Prague, 1925.

The investigations on the effect of drainage on the physical condition and the mechanical composition of soil were carried out by the Pedological Section of the Technical Bureau of the Bohemian Land Cultivation Board, in the years 1920-1924, in the loamy and heavy soils of N. E. Bohemia, in the districts where these soils are for the most part drained. The soil investigated consisted of light Podsol brown earths, or heavy Cretaceous soils with an underlying layer of marl. Nineteen cases were considered in drained, and nine in undrained situations. With regard to the mechanical construction and physical condition, 90 soil profiles were examined in all, mostly to a depth of over 1.0 m., by 414 physical and 407 mechanical analyses.

For the investigation a combination of KOPECKY'S physical and mechanical analysis was used, and samples of soil which were always taken from several depths of the same sounding in the natural bed. On the drained situations the soundings were chosen at different distances from the drain, mostly at 1.0 m. or 3.0 m. distance, in between the drains. The results of the mechanical analyses, together with the determination of the carbonate of lime, are compared in tables.

From the results of the investigation the following statement can be made: —

Where drainage had been carried out, a free underground water-level up to the depth of the drainage was not noticeable in any of the situations under observation, and its formation in the soundings between the drains could not be followed up. By drainage a quick removal of the excessive moisture of the soil is effected, and the firmly bedded soils are changed by drainage from a humid to a dry condition. The distri-

bution of moisture in drained soils can be determined by the physical analysis, and the effect of the percolation of water through the soil in respect to the formation of individual levels can be checked by mechanical analysis.

The formation of the type of soil follows as a function of the percolation of water through the soil, and is therefore of great importance in cultivation technics. By reduction of the contents of electrolytes, fine soil substances are released in the upper (elluvial) layers, and deposited at the depth to which the penetration of the percolating atmospheric water as a rule reaches (illuvial level). The impoverishment of the upper layers and the enrichment of the subsoil can be followed in the results of the mechanical analyses.

In the cases given, in loamy soils the difference in content of the fine constituents, which can be washed out, of the arable crust and the illuvial layer goes up to 10 %, and in heavy soils up to 20 %, according to composition.

The process of the formation of Podsol soils also arises from the washing out of the carbonate of lime from the elluvial levels A,A1 and its deposit in the illuvial level B.

For measuring the amount of drainage, the investigation and characterization of the red-brown illuvial level B1, which in the cases in question usually shows itself at a depth of 0.75-1.0 m., is of the greatest importance. It is expressed by the greatest content of fine constituents which can be washed out in the soil profile concerned, by a high carbonate of lime content, by notable enrichment by iron compounds, by the smallest pore-volume and consequently the worst structure and lowest absolute air capacity which in technical practice influences conditions of permeability.

According to the investigations carried out, the illuvial level (B) signifies practically the limit for the penetration of atmospheric deposits, the lower limit of the changing of the physical condition of the soil during the time of vegetation, and therefore probably also of the total activity of the soil in a chemical and biological respect. From the technical cultural standpoint it denotes the most impermeable layer in the soil profile concerned, on to which oozes the water containing the precipitates, whose five constituents are redeposited, causing thereby a continual closing of the pores of the soil.

In loamy soils the illuvial level still remains fairly permeable; in heavy soils the absolute air capacity sinks to below 0.5 % of the volume, causing this layer to become inaccessible to the penetration of water, air, and consequently also roots.

The moisture condition, during the time of vegetation, undergoes considerable alterations in the alluvial levels only, whilst the deeper layers show a similar condition of moisture in the spring and autumn. In loamy situations the momentary condition of the humidity is lower in spring than the absolute water capacity, and the humidity is evenly distributed in all layers. In heavy soils the upper layers are usually saturated in spring to the absolute water capacity, sometimes beyond

in which case the elluvial layers often become marshy. The deeper layers below the illuvial level at the same time show a lower degree of humidity, because the influence of the atmospheric deposits does not reach to this depth.

The aeration expressed by the momentary air-content is greatest in the elluvial layers, falling gradually until reaching the illuvial level, below which no notable alterations in air-content take place. The aeration is greater in autumn than in spring. The above differences are greater in loamy soils, and consequently these soils are also more active than the heavy soils. In the latter the greater aeration of the upper layers is caused by intensive drying and the falling out of colloidal substances. The crumbly structure attained in this way, however, is in an unstable state, and its maintenance must be supported by surface drainage.

From fairly numerous results of the investigation of the places brought under observation, it appears, however, that the infiltration of the water, and the concentration of the percolation through the soil in the direction towards the drain, after a long time also exerts a notable influence on the lixiviation process, which is especially important in heavy soils. The effect of drainage on the metamorphosis of the type of soil of the drained situations is shown in the following manner:

In the upper layers the content of fine constituent parts capable of being washed out and of the carbonates increases from the drain towards the central point between the drains. At the same time the pore volume sinks with the increasing distance from the drain. From this it can be concluded that the elluvial layers are cleansed most by the drain, and so they show the best structure.

In the illuvial layer, on the other hand, the content of fine constituent parts capable of being washed out, and of carbonates, is greatest near the drain, where also the pore volume is smallest; towards the middle between the drains the content of fine constituent parts and carbonates is less, and the porosity greater. The illuvial level, as a result of the deposit of the fine substances near the drain, possesses the worst structure, and is most impermeable, which is very important particularly in heavy soils.

By the influence of the drainage the physical condition of the soil undergoes rapid alterations, especially in the upper layer, with diminishing tendency as the depth increases, and in such a manner that in the illuvial level these alterations, particularly with heavy kinds of soil, almost disappear.

For the percolation of the water through the soil, the composition and structure of the soil in the illuvial level B is decisive; for the valuation and characterization of the conditions of the soil for drainage purposes, the samples of soil concerned must be taken from this level for analysis.

As the illuvial level B in loamy soils is fairly permeable, in such soils a deeper drainage (up to 1.40 m., max. 1.50) can be chosen, in order to force the percolation of the water to the drain through a stronger layer of soil. The humidity distributed in this manner through a greater

layer of soil, with corresponding capillary attraction, gradually becomes of value at a time of dryness.

In heavy soils the unfavourable condition is caused by the precipitated water, scanty aeration and high water capacity as a result of a superfluity of colloidal substances. The improvement of the structure of the heavy soil can be effected by the elimination of the colloidal constituent parts, by quick removal of the humidity, or by intensive drying. For this purpose, in these soils, superficial drainage (about 1.0 m. deep) is better, stopping at the illuvial level, and connecting directly with the elluvial layers, from which it quickly drains off the water. By this means, the washing out of the colloidal constituents by the drainage water in the upper layers is assisted, and so its coherence and excessive water capacity are reduced. In heavy soils the illuvial level represents the natural depth of the drainage, as it separates almost completely the elluvial layers from the deeper ones. Under our climatic conditions the influence of frost does not reach the depth of the superficial drainage, and moreover, this never conducts water in the full profile in winter, so that the pipes cannot be injured by freezing.

The achieving and maintaining of the crumbly structure is much more difficult in heavy than in loamy kinds of soil. In these situations, after carrying out the drainage, liming is advisable in order to get a coarser structure; for this purpose, in marly situations, the deposit from the deeper layers can be advantageously used, whereby the carbonate of lime originally washed out can be partially given back to the upper layers. In laying drains in heavy soils, it is better to cover the drain with soil from the upper elluvial layers, in which there is a lower content of fine parts that can be washed out, and which are therefore more permeable. L. SMOLIK.

Experiments in Sub-irrigation.

ROSSI E. *Nuovi Annali dell'Agricoltura del Ministero dell'Economia Nazionale*, p. 25 to 50, year V, No. 1-2. Rome, 1925. Provveditorato Generale dello Stato, Libreria.

An irrigation system in which the water rises from the subsoil to the roots, that is to say sub-irrigation or subterraneous irrigation, appears more rational than the application of water at the surface of the ground or the usual irrigation. Sub-irrigation should imitate what happens in semi-arid countries during the dry season, in which care is taken by suitable cultivation to keep the surface of the soil thoroughly friable and broken up, however dry, while the moisture is allowed to replenish the roots from the reserve in the sub-soil by means of the natural capillary action.

Conceived in this way the chief aim of sub-irrigation should be to reduce the loss of moisture by evaporation from the surface of the soil, a very important object when little water is available.

Attempts at sub-irrigation are not lacking, especially in America; but apparently it is only at Sanford in Florida that sub-irrigation has given better results than surface irrigation; elsewhere it has generally been abandoned.

At the present time three systems of sub-irrigation are known :—

1. LEE's system suggested for orchards. A subterranean system of iron pipes, composed of a main pipe of 15 cm. and lateral ramifications of 7.5 cm. is arranged running along the rows of trees and has an aperture which can be opened or closed from outside corresponding with each tree.

2. The SANFORD-MONTERISI system consists in placing, at a depth of 40-45 cm., a series of earthenware pipes 20-25 cm long, and 80 mm. in diameter inserted in each other in such a way that the water escapes freely at the junctions. These pipes branch out from a closed main system of piping situated in the highest part of the field. The distance between the lines of underground irrigating pipes is 5.40-7.20 m.

3. Systems of *porous pipes*. ULPIANI proposed to make use of very porous earthenware pipes cemented one to another so as to form a perfectly closed system which could be immediately filled with water. The water exudes slowly through the pores of the earthenware and is absorbed by the soil with the greater avidity, the drier the soil.

The MONTERISI system was adopted on the farm of the Station near Bari, selecting a plot of ground which at a depth varying from 50 cm. to 1 m. presented a slight formation of crust, very friable however and probably not continuous. The water under pressure coming from the Apulian aqueduct was introduced by means of a flexible connection directly into the head of the subterranean system of pipes, after having passed through a Meinecke meter.

For experimental purposes the lines of pipes were placed at various distances between 2.50 m. and 5 m. and at depths of 40 cm. and 50 cm. For comparison with the sub-irrigation, surface irrigation with the furrow method, that is to say by infiltration, was practised in plots adjacent to those sub-irrigated. The soil is reddish alluvial sandy-loam, rather friable.

The porosity was determined at the beginning of the experiments and at the end, namely in September ; in the unirrigated plot, which was kept carefully hoed, the caking of the soil was nil at the surface and negligible at a depth ; in the sub-irrigated plot it was nil at the surface, slight at a depth ; in the surface irrigated plot it was high at the surface, considerable at a depth.

Diffusion of the water around the system of piping.

Vertical diffusion from the system of piping to the surface. — In one hour and a half (capillary ascension measured in Wahenschaffe's tube) the water ascended 25 cm., in eight hours it already reached 40 cm. After which the ascension took place more and more slowly, though despite this after 36 hours 50 cm. was passed. In the soil, directly after the water had been administered the following degrees of moisture were recorded :—

	4th row (50 cm.)	5th row (40 cm.)
In contact with the pipes	20.00-21.22 %	20.75-22.3 %
10 cm. above	17.13-19.50 »	20.00-21.13 »
20 » »	15.05-18.35 »	18.52-19.25 »
30 » »	12.45-15.20 »	16.70-18.42 »
40 » »	9.50-10.15 »	— — »

The higher figures were recorded within 20 metres of the inlet, the lower figures in the 20 metres further away.

At 10 metres distance fr m the system of piping, where certainly its influence could not reach, there was, at a depth of 40 cm., a degree of humidity, slightly less than that at the surface of the sub-irrigated ground.

L a t e r a l d i f f u s i o n .— In 1924 after 1-7-14-21 days from the third sub-irrigation, the humidity, at 1 m. from the pipe, at 20 cm. depth, gradually decreased from 13.35 % to 8.00 % ; at 40 cm. depth, from 13.60 % to 8.50 % ; at 2 metres from the pipe at 20 cm. depth from 12.30 % to 7.02 % ; at 40 cm. from 13.18 % to 8.45 %. At 4 metres distance from the pipe the humidity scarcely exceeded 10 % in the first 24 hours, at 6 metres it remained much below this. At 8 metres distance the effect of the sub-irrigation was not felt. At 4 metres, 7 days after the watering, the humidity had already decreased to below 10 % ; at 2 metres after 14 days, at 1 metre after 3 weeks.

D i f f u s i o n b e t w e e n t h e s y s t e m s o f p i p i n g . — In 1923, in which the reserve water in the soil was greater, after the sub-irrigation in July a degree of humidity in excess of 15 % was maintained for over 14 days, even between the systems of piping 5 metres apart. After the sub-irrigation in August however, the humidity after 7 days had already decreased below 10 % between the systems of piping 5 metres apart and after 14 days between the two rows 2.50 m. apart.

In 1924, after the 3rd sub-irrigation given at the end of July, at 20 cm. depth, 15 % of humidity was attained and maintained for some days only between systems of piping 2.50 and 3 metres apart, 10 % was maintained for 7 days also at a distance of 5 metres, for 14 days at 3 metres, for 2 days at 2.50 metres.

At a depth of 40 cm. 15 % of humidity was reached and maintained for 14 days between systems of piping 2.5 m. apart, for 7 days between pipes 3 and 4 m. apart, for a few days between pipes 5 m. apart. 11.10% of humidity was maintained for 21 days at 2.50 and 3 m., for 14 days at 4 and 5 m. distance between the pipes ; however at 4 m. distance after 21 days 9.90 % of humidity was still found at a depth of 40 cm.

Such records, made in the hottest and driest season and repeated every time at various points at different distances from the inlet, permit of the conclusion that in our installation a distance of 4 m. between the system of piping may be adopted even for a rotation of 3 weeks, while a distance of 5 m. requires a rotation of 2 weeks, if it is desired to maintain, at least at 40 cm. depth, a humidity of 10 %, the minimum necessary for the growth of herbaceous plants.

D i f f u s i o n b e l o w . — Much more water penetrates and is maintained below the systems of piping than above them. Part of this reserve rises by capillarity, but substantially this system of sub-irrigation tends, in soils of our type, to enrich the subsoil with water at a depth to which it is certain that the roots of common summer grown plants do not reach.

D i f f u s i o n a c c o r d i n g t o t h e i n i t i a l h u m i d i t y — The moister the soil is before the application, the greater is the humidity

obtained by the same quantity of water and the longer is it maintained. Therefore it is better to begin sub-irrigation in spring, when the soil still has a greater humidity than 10 %, and not to wait until the humidity falls below that percentage. The reserve of humidity in the subsoil also influences the rapidity with which the water runs through the sub-irrigating system of piping. As summer advances the drying is more rapid after each application.

In the tests in 1923 a total of 4493 cubic m. of water was required per hectare; in 1924 even more was required. Such a high consumption must be caused, in addition to that by or inary evaporation (even with sub-irrigation there is loss of water by ordinary evaporation) and by the very strong transpiration of the plants in summer months, by the dispersion of water, in the subsoil, as in fact there have been means of recording.

The water's rate of progress is rapid in the immediate vicinity of the inlet, then progressively slower until it requires a very long time to get through the last metres. This is obviously due to the progressive decrease in the power of flow. To obviate this drawback I experimented with longer pipes of 70 and 95 cm. in 1924 in a new installation. These preliminary experiments prove that, at least in our conditions of soil, time and water are saved by using pipes of various length, placing the longest at the inlet and then gradually the shorter. For the installation of a field of sub-irrigation, according as use is made of pipes of various lengths or of pipes all 25 cm. long, an expenditure of 9200 to 10 000 lire It. per hectare has to be met. At 9200 lire, counting on a duration of 10 years there would be an annual cost of amortization and interest of L. 1380.

For surface irrigation, calculating a maximum of 15 irrigations from the 1st May to the 30th September, which really in this climate should not ever be necessary, the cost of labour does not exceed 800 lires. The factor therefore which would make sub-irrigation preferable to surface irrigation is the consumption of water.

Principal conclusions.

Surface irrigation causes the soil to cake strongly at the surface, considerably at a depth; sub-irrigation slightly at a depth, not at all on the surface. A few hours suffice to cause the moisture from underground pipes to rise to the surface. A depth of 50 cm. is to be preferred, because pipes at 40 cm. keep the surface moister, thus favouring evaporation and the development of surface weeds. Laterally to the pipe however humidity is maintained longer at a depth and favours the development of plants with tap roots and bulbs, including some weeds which cannot be got rid of by hoeing. The distance between the system of pipes should not exceed 5 metres; at 8 metres there would be no effect.

With the system of open junctions (SANFORD-MONTERISI), experimented with by us, most of the water is lost in the subsoil, if the latter is permeable, and is not utilised by surface rooted plants. This leads to a waste of water, which however, decreases at every successive irrigation. It is best to make use of pipes of different lengths to render the escape of water at each junction constant, with great saving of time and water.

Among the plants experimented with, maize, beans, tomatoes and cotton produced more with surface than sub-irrigation, while soy-bean, lentil, sorghum, sesame, *Vigna sinensis* (forage) produced more with sub-irrigation.

With regard to dry cultivation, the increased production obtained with sub-irrigation pays for the cost of the installation and consumption of water for plants which grow all the summer, while for early produce and for some varieties of soy-bean the advantage depends on the course of the season. Super-irrigation costs less including labour and water than sub-irrigation with the MONTERISI system, but I abstain from a final judgement, having worked in soil conditions unfavourable to this system.

THE AUTHOR.

Tests of Surface Tillage for Maintaining Humidity in the Soil.

ROSSI, E. Agricultural Experimental Station of Bari, No. 6, pp. 27, and 1 diagram, April 1926.

Various experiments carried out by eminent agriculturists have demonstrated the utility of surface tillage for maintaining existing humidity in the soil. The tests therefore, dealt with in the above noted account, were made with the aim of determining the importance of the phenomenon itself, working under quite special conditions of soil and climate (Southern Italy), rather than to demonstrate the fact now long established. The enquiry was further extended to the greater or less influence which surface loosening of the soil (2-3 cm.) and working it to a certain depth (12-15 cm.), might have on the question. Results were obtained on ground which was planted with vines, one part of which was prepared after the manner of the district, with furrows designed to get a large collection of water during the spring rains along the rows of vines, planted precisely at the bottom of the furrow. The humidity was determined at different depths by taking always for each plot of the 4 types :—(unworked — surface loosened — worked to about 15 cm. — with furrows) two samples at the same point, the first at about 20 cm. depth the second at about 40 cm. depth.

The soil which was the subject of the experiment is a soil derived from the decomposition of the so-called "calcareous tufas" belonging to the Pliocene or Post-pliocene formations. These are sandy calcareous rocks, more or less coherent and containing scattered fragments of mollusc, echinoderms, foraminifera, corals and other more or less macroscopic marine fossils. After Cretaceous they are the most common soils in Apulia.

The experiment, was started on the 14th March, and finished on the 30th August.

In the course of the experiment fully 20 observations were made.

The best result was given by the plot loosened at the surface and by the plot arranged in furrows, which after the initial preparation of the soil on the 14th March, was worked again to relevel the surface on the 16th May; the other two plots were loosened on the 17th April, the 16th May and

the 23rd June ; on this latter date the surface of the fourth plot, which, as noted above, was kept in furrows up to the 16th May, was slightly loosened. The minima percentages of humidity (mean of the humidity of the soil) in a thickness of 10 cm at a depth of about 40 cm. occurred :—

In the unworked plot	on the 1st August :—	3.085 %
In the plot loosened at the surface	on the 10th August :—	5.025 %
In the plot loosened to a depth of 15 cm	on the 10th August :—	5.45 %
In the plot arranged in furrows .	on the 23rd July :—	5.625 %

The maximum difference between the humidity of the loosened plots and the unworked plot was recorded :—

for the plot loosened at the surface, on the 7th May :—	4.90 %
for the plot loosened to a depth of 15 cm. about the 7th May :—	3.75 %
for the plot arranged in furrows on the 16th May :— .	3.79 %

On the days in which the maxima differences of humidity were registered there remained in the plot loosened at the surface and in the plot arranged in furrows a quantity of water double that remaining in the unworked plot, and not much less than the quantity of water which remained in the plot loosened to a depth of about 15 cm.

The humidity fell below 6 % twice in the plot loosened at the surface ; once in the plot arranged in furrows ; fully 6 times in the plot loosened to a depth of about 15 cm ; while in the unworked plot, from the 16th May to the 20th August, or for fully 11 observations, the humidity almost always varied between 3 % and 4.95 %.

It is a noteworthy fact that on the arrival of the dry period, the surface of the unworked plot became more and more compact, until a pan 5-6 cm thick was formed, so hard that it required great effort to break it every time that samples were taken. Below this pan the soil continued to remain very loose and the water contained in the soil, owing to its intimate and uninterrupted contact with the hard stratum over its whole surface, had been able to go on evaporating until the humidity was reduced to such a minimum, as is seldom reached in soils of sub-humid regions and only very exceptionally in those of humid regions.

Contribution to the Mechanical Analysis of the Soil.

SEIWERTH, A. Prilozi mehanickoj analizi Ha. Glasnik za Lumske pokuse I. 1926. Zagreb.

The writer gives some results of comparative analyses of soils carried out by means of ATTERBERG's and KOPECKY's apparatus using distilled water and aqueduct water of the town of Zagreb.

In table 1 are found the results for soil particles having a diameter of less than 0.002 mm. of parallel analyses made at the same time with

distilled water and acqueduct water in ATTERBERG's apparatus. The figure shows the parallel test of sedimentation of a loam in distilled water and aqueduct water. After 24 hours of sedimentation, for 20 cm. of height, the soil in the aqueduct water is almost entirely found at the bottom. The liquid was so clear that the dark line behind the apparatus could be seen. On the other hand suspension in distilled water remains so dense that the dark line behind the apparatus could not be seen through the liquid.

In Table 2 are set o t the quantitative differences found in the different samples of soils by washing them with distilled water and aqueduct water in KOPECKY's apparatus. The parallel analyses were made with each sample of soil always in the same apparatus. In the same table it is seen that the small differences in temperature for the same soil in the same water are without perceptible influence on the results of the analyses.

Table 3 shows that even slightly greater differences of temperature have not had any greater influence.

From the heading " duration of washing " of table 2 it is seen that the time required to carry out an analysis varies very much according to the samples, but it is generally shorter in distilled water than in aqueduct water. For sample K, table 4 shows the influence of the too hasty stoppage of washing on the results of a mechanical analysis.

For the cylinders of KOPECKY's apparatus the time in which one litre of water runs off is 201.03″ and not 202″ as is found in books. But it is seen from table 5 that this small difference in the time of running off has no influence on the results of analyses. In the same table are found the results obtained by washing soil or quartz sand when the time of running off is 202″ or 200″.

L. SMOLIK.

Effect of Mulches on Soil Temperatures, during Warmest Week in July 1925 at Davis, California.

SMITH, Ph. D. sen. University of California, Davis.

The highest soil temperature found was in the bare plot, where on July 17, 1925 at a depth of one-half inch the electrical resistance thermometer registered 143 degree Fahrenheit. Temperatures were obtained at a depth of one-half inch in only two plots and the results showed that in the bare plot it was 10 degrees warmer during the day on the average and 5.6 degrees cooler at night than on the plot covered with perforated black paper. In these same two plots temperatures were obtained at the six inch depth. In the bare plot the average day temperature at 6" depth for the week was 0.9 degrees higher and the average night temperature was 0.6 degrees higher than on the area covered with perforated black mulch paper.

In the bare plot where temperatures were obtained at depths of ½, 3, 6, 12, 24 and 36 inches, decided differences were found between the day and night temperatures down to a depth of 12 inches.

Where a black paper, mulch paper non-perforated, was used, the average temperature for this warm week at a depth of 3 inches was 97 degrees

as compared to 91.1 on the bare plot. The next warmest plot was that covered with perforated black paper where it was 90.9, followed the gray paper non-perforated plot with 87, and finally the gray paper perforated with 85.7 degrees

The maximum temperatures at the 3 inch depth occurred usually about the same time which was two hours after the maximum air temperature was reached. The range in these soil maxima was 13 degrees at the 3 inch depth.

The minimum temperatures at the 3 inch depth occurred on the average 1 hour and 40 minutes after the minimum air temperature and showed a range of 7.4 degrees.

Temperatures taken at the 12 inch depth showed that under the black non-perforated paper it was on the average 5.5 degrees and under the perforated black paper one degree warmer than in the bare plot during the day, while under the gray non-perforated paper it was 3.6 degrees colder and under the gray perforated it was 4.9 degrees colder than in the bare plot.

The average night temperatures at the 12 inch depth were highest under the black non perforated paper and lowest under the gray perforated paper.

The maximum temperatures at the 12 inch depth occurred usually at about the same time, which was 8 hours after the maximum air temperature was reached, and showed a range in the various plots of 11.6 degrees. The minimum temperatures at the same depth occurred on the average 6 hours after the minimum air temperatures and showed a range of 10.6 degrees.

The colour of the soil surface or the colour of the paper mulch and whether the paper is perforated or not produce a marked effect on soil temperatures.

The warmest soil during this week was that covered with non-perforated black paper and the coldest was that covered with the gray perforated paper. X.

The Application of Archimedes' Law to the Mechanical Analysis of Soil.

Smolik J. Využití Archimedova zákona při mechanickém rozboru půd. *Zemědělsky Archiv.* Prague, 1925.

Archimedes' law can be applied with advantage for the simplification and shortening of the practical mechanical analysis of mineral soils according to Kopecky.

For this purpose the various particles, after being separated into their size categories, are transferred from the cleansing cylinders into weighed Erlenmeyer flasks (the various sizes of flasks 1 ½ litres 500 ccm., 300 ccm., serve very well) which are fill d with water and then weighed. The net weight of each category in the water is multiplied by 1.6, and so the weight in the air is obtained.

If it is a question of percentual data, then the net weight in the water is multiplied by 3, when 53.33 g. of soil are taken for the analysis, or by 3.2 if 50 g. of the soil are taken. VERF.

Soil Chemistry.

The Use of the Quinhydron Electrode for Measuring the Hydrogen-Ion Concentration of Soils.

BAVER, L. D. (Ohio Agr. Exp. Station), *Soil Science*, Vol. XXI, pp. 167-179. Baltimore, Md., 1926.

A study of the quinhydrone method for determining the hydrogen-ion concentration of soils leads to the following conclusions:

1. The saturated calomel cell is the most convenient to use since it is most constant and does not require a reversal of poles below pH 7.68.
2. For accurate results 0.05 gm. of quinhydrone per 15 cc. of solution is sufficient. The quinhydrone may be added in solution provided a fresh stock is prepared each day.
3. The potential is very constant with this electrode with the exception of soils above pH 8.0. It is reached quickly and easily.
4. The quinhydron and ordinary hydrogen electrodes compare closely. Variations were obtained from 0 to 0.2 in pH, which is considered close enough for most soils work.
5. The most desirable soil-water ratio to use as a standard with the quinhydrone electrode is the ratio of 1 : 1. It gives results comparing closely with those obtained with the ordinary hydrogen electrode.

The quinhydrone method has a very distinct advantage over the ordinary hydrogen electrode inasmuch as the apparatus required is simpler, both in construction and operation, and requires a much shorter time to reach equilibrium. The method is applicable to field as well as laboratory purposes. J. S. JOFFE.

On the Degree of Resistance of various Limestones to Acid Solutions circulating in Agricultural Soil.

BOTTINI, E. (Torino S. Stazione Chimico-agraria). *Le Stazioni sperimentali Agrarie Italiane*, Vol. 52, No. 7-9, pp. 268-288. Modena, 1926.

A large number of products are called limestones which, while having allied chemical compositions, are very different in structure and physical properties ; this diversity of structure evidently entails a different degree of resistance to physical and chemical agents, and hence a different behaviour of the various, types of limestone towards agricultural soil and the roots of plants. The researches made by the writer admit of the following conclusions :—

1) Limestones as regards their behaviour towards acid liquids (aqueous solution of CO_2), 1 % aqueous solution of acetic acid, 5 % acetic acid, N/10 hydrochloric acid, and N/10 nitric acid), may be divided into three groups. The first group includes the marly, concretionary, sandy and fos-

siliferous limestones, which are those most easily decomposed. The second group includes the argillaceous limestones which are more resistant than the previous kinds. Lastly, the third group includes dolomitic, saccharoid and compact limestones which are those least easily decomposed.

2) The decomposition of limestones follows fairly closely their respective specific weights, the smaller the specific weight, the more easy the decomposition. Exceptions are in the first group, the concretionary limestones and, in the third group, the dolomitic limestones. For these latter, however, the anomaly is easily explained by their peculiar composition.

3) The degree of resistance of limestones varies with their geological disposition, limestones belonging to the deepest strata of the ground being less easily decomposed than those belonging to more recent strata.

4) It is thus clearly proved that in soil investigations not only should the content in $CaCO_3$ be taken into account, but also its behaviour towards decomposition which varies according to the nature of the soil itself.

Contribution to the Explanation of the Effect of Colloidal Silicic Acid in increasing Production in Sandy Cultivations.

DUCHON, F. *Zeitschrift für Pflänzenernährung und Düngung.* Part A, 4th Year, Vol. 5.

The favourable effect of colloidal silicic acid on productivity where there is insufficient phosphoric acid manuring in sandy cultivations rests mainly on the physical qualities of the colloids, which improve the physically unfavourable conditions of the sand. The physical improvement then shows itself in a better utilization of the apparently small but actually sufficiently large additions of phosphoric acid. The natural soils contain, with suitable tillage, sufficient indeed abundant quantities of colloids. Sterile sands, poor in colloid substances, of similar character to the sand used in pot cultures can be improved in practice by stable manure or green manure, which has therefore been introduced and proved in practice. By this means the production factors of the food material supplied in the form of artificial manures is increased at least in the same measure as by the use of colloidal silicic acid in pot cultures. And so the use of colloidal silicic acid has no importance in practice. Just as the established suitability of the Na in pot cultures to take the place of K to a certain degree has no significance, so colloidal silicic acid as a means of saving phosphoric acid is also of no importance. The means by which one can be assured of the highest production factor of the phosphoric acid manure, are to cover the natural soils with those which in practice increase the fermentation processes of the soil. Such being the case then, if we want big agricultural harvests, it will not be possible to replace full manuring which contains the indispensable phosphoric acid manure, in other words we must use easily soluble phosphates.

L. SMOLIK.

On the position of the Practical Agriculturist to the Question of the Acidity of the Soil.

EINECKE A. *Illustr. Landw. Ztg.* Year. 45, No. 28, p. 339. 1925.

The author warns against the under estimation of the importance of the question of soil acidity for the condition of the soil and the health of plants. The comprehension of the " condit:on of the s il " first emphasized by HUNIG, appears to be of special importance for guarding against acid and alkaline injuries. For example we know that a mineral soil which is rich in fine earth, humus and lime in a finely distributed condition, and possesses normal water characteristics, shows a strong " digestive capacity " for all manuring materials, and so an exact knowledge of the contents of fine earth, humus and lime in the soils of a farm is of the greatest importance to the practical agriculturist.

He also points out the importance of the fact that by using physiologically acid manuring material on soils which are already acid great damage to plants may easily occur, therefore a proper consideration by the agriculturist of the questions pertaining to liming in exact amounts is essential, and the suitable application of physiologically alkäline, neutral or acid manuring materials must be striven for. He gives warning against the agriculturist relying on the results of his own investigations with the various " acidity testers " etc. K. SCHARRER.

Studies on the Influence of Lime on the Soil.

GEHRING, A. and WEHRMANN, O. *Landw. Versuchsstat.*, 103, 279, 1925.

Taking the speed of nitrate formation as a measure of the influence of lime on the soil, we got the following results :— quick-lime, marl, " without manure ", lime of potassium and residual lime. The influence of the residual lime on the physical condition of the soil shewed no better results than those of normal lime manuring, while biologically it was distinctly injurious. Certain associations exist between physical quality on the one side and CO_2 production and nitrification on the other Only the residual lime and the lime of potassium do not obey this law; the first named material, in a mechanical respect, produces nearly as great an effect as quick-lime, but as regards CO_2 production and nitrate formation it remains far behind the unmanured plot, evidently because of its high content of chlorides, which have a disinfecting effect. On account of its high potash contents the lime of potassium shows an inclination to cause coagulation. As regards the breaking up of the organic matters in the soil effected by manuring with the various kinds of lime, it appears that, measured by the quantity of CO_2 produced, quick-lime has the best effect, followed by residual lime, marl and lime of potassium. D. MAYER and HISSINK have mentioned processes for separating absorptive combined lime from that soluble in acid. The former works with a 10 % NH_4Cl solution, the latter with N/1 NaCl solution. Comparative experiments of the authors induced them to work in accordance with the more detailed but more exact methods of HISSINK. They

also give an account of a theory of method for determining the highest combination capacity of lime, and, in conjunction with the process of HISSINK, the so-called *lime saturation factor*; 25 g. of the same soil has 40 ccm. saturated quick-lime solution poured over it, and is then shaken for 30 minutes. A few drops of phenolphtalein are then added, and CO_2 is introduced until colour appears. The CO_2 lying over the liquid is removed by introducing air, while that in solution in the liquid is removed by heating for a short time to 60° and by blowing air through. A further 20 ccm. of the saturated quick-lime solution is allowed to run in, it is shaken for 30 minutes, CO_2 again introduced, and this process is repeated until the desired quantity of liquid, 100 ccm., is reached. After the last saturation of the remaining lime with CO_2, as much solid sodium chloride is added to the quantity of liquid as is necessary to make the solution normal. It is then heated to 80-90°, allowed to stand for 12 hours, and the exchangeable lime is determined by separating the absorbed lime from the carbonate in the manner suggested by HISSINK. The quotient, determined according to HISSINK, of the available contents of absorbed lime and the maximum content, determined by the authors' methods, gives the degree of saturation of the soil. At a saturation degree of 70 the requirement of lime of the soils examined ceases. With soils having a degree of saturation of 70-72, the authors could not obtain increased crops by applying more lime. There consequently appears to be a parallelism between the degree of saturation and increased production. It further appeared that if no hydrolytic acidity occurs in a soil, there is also no necessity for lime; in such cases, therefore, it is superfluous to carry out the methods of determining the degree of saturation. K. SCHARRER.

Critical Investigations on Neubauer's Seedling Method.

GUENTHER, E. *Zeitschrift f. Pflanzenernährung und Düngung.* Vol. V, Sect. I, Part B, 1926.

The author examines the influence of light and of the soil reaction on assimilation of foodstuffs by seedlings. The analysis figures of the same soils under different light conditions during growth show that the influence of light plays a subordinate part, and under normal conditions can be entirely neglected. With a soil in which, having otherwise the same contents of food materials different degrees of acidity were produced by the addition of calcium carbonate, it is clear from the results of the analysis that the difference of soil reaction does not affect the food assimilation by seedlings, unless it is very marked. L. G.

Taking Samples of Soil from the Field.

HAEHNE. H. *Zeitschrift für Pflanzenernährung und Düngung* Vol. V, Sect. I. Part B. 1926.

Mixed samples, which came from a different number of places distributed uniformly over the field under investigation, were examined by

NEUBAUER's seedling method and the results compared, in order to be able to work out a definite rule for taking samples of soil from the field. It appeared that an average sample from 10-15 places in fields which can be described as uniform is quite sufficient, whilst if taken from only 5 places, the probability of finding the correct average is too small. The average of the samples and not any individual one must be using for judging the field. GOERNER.

Nitrification Studies

HALVERSEN W. V. Oregon Agricultural Experiment Station, Cornwallis.

Nitrification tests were run on a series of fertiliser plots to determine the relative value of several methods. These plots are located on Willamette silty clay loam, which is a prominent soil type of the Willamette Valley. It normally has a pH value of about 5.5 and is one of the most fertile soils in that locality. In these tests the power of the various soils to produce nitrates from their own organic matter, from 30 mgs. of N as ammonium sulphate, from the same amount of ammonia sulphate added with 210 mgs. of $CaCO_3$ and also from 0.1 % of blood meal were determined. In all cases 100 gms. soil were used at optimum moisture content. The nitrate production in the soil itself was so small during the 28 days incubation period as to give little information : the other methods gave parallel results except on one plot which received heavy applications of sulphur, superphosphate and potassium sulphate, in which case the blood meal gave comparatively higher yields of nitrate. It is significant that on plots which had received excessive applications of lime in the field, the yield of nitrates was proportionately higher in the tests where the $CaCO_3$, was added with the ammonium sulphate. Over this wide range of acidity and fertiliser treatment the merits of one method over another were not apparent, though a range of H ion concentration from 5.2 to 7.2 and a wide variation in buffer content prevailed.

The nitrate content of fallow plots adjacent to the fertiliser plots which had received 0, 2, 4, and 6 tons of lime respectively per acre was determined at several intervals during the growing season, and showed that lime promotes the production of nitrates in this type of soil. The most nitrate is found where the largest application of lime is made, even though that application is excessive. The production of nitrates in the soil is in agreement with the laboratory tests and is quite necessary and should be taken in consideration in determining the nitrifying power of a soil. Numerous analyses, however, of soils on which crops are growing fail to yield more than a trace of nitrates until the crop is harvested.

That a difference in the physiological efficiency of the nitrifying flora of soils exists is shown by the parallel results obtained when nitrification tests are run in both soil and solutions. However, the fact that nitrification is more dependent on the soil conditions than the biological efficiency is evidenced by the failure of soils to produce larger quantities of nitrates after being inoculated with a soil infusion containing organisms of a higher physiological efficiency. X.

On the Retension of Superphosphates in Acid Soils.

KAPPEN, H. *Deutsche landw. Presse*, 52, 489 and 496, 1925.

On the basis of his experiments, the author comes to the opinion that the fear that superphosphate-phosphoric acid can form such compounds in the free acid soil as to check the plants, or at least have less effect than on other soils, is unfounded. His vegetation and chemical solution tests showed that the presence of excessive Al- and Fe- sesquioxide did not have any ill effect on the absorption of the Al- and Fe- phosphates as both of these are easily assimilated by plants. K. SCHARRER.

The Recovery Power of a Soil as indicated by Incubation.

MARTIN, F. C. Laboratory of Plant Nutrition, University of California. Berkeley, California, 1926.

A brief review of the characteristic behaviour of a fertile fines andy loam soil under conditions of continuous cropping with barley and of continuous fallowing, as reported in earlier papers from this laboratory, is given.

This soil was used as a culture medium for various crops in an absorption study in the greenhouse, as the result of which the crops, maize, oats and turnips, reduced the concentration of the liquid phase to a low level and entirely depleted the nitrate.

These residual soils were incubated at 27-29° C. after the removal of the different crops and screening to remove some of the larger roots. The moisture was kept constant (14 %). The soils were studied by displacing the soil solutions by the BURD and MARTIN method at from 9 to 161 days after incubation was started, then determining the total concentration (conductivity) and the composition with respect to the more important plant food constituents.

The results of the preliminary study of a soil by this method showed that during the first few days an indication may be gained as to the residual effects of different types of plants on the activity of the soil organisms producing nitrate. The soil, after maize and after turnips, increased much more rapidly during the first two weeks than the soil after oats, bearing out the observations of LYON and BIZZELL several years ago on maize and oats on field plots of soil. Continued incubation for five months showed that following all three crops, the concentration and composition reach levels which are very close to that reached in this soil after eight years fallowing in a container in the field.

The method gives promise of application to the study of the potentialities of a soil for supplying constituents to its liquid phase when its equilibrium is disturbed, giving the information in a very short time.

Comparison of the Methods of Determining the Concentration of Hydrogen Ions of Soils.

NIKLAS H. and HOCK A. *Landwirtschaftliche Versuchstationen*, 104, 87, 1925.

The colorimetric method of MICHAELIS was compared with the colorimetric process of CLARK and LUBS, with the result that the agreement can

be described as very good, as the differences between the electrometric and colorimetric measurement of the soil reaction, according to the experiments of the authors, did not amount, on the average to more than 0.1 in pH values, and the electrometric method being recognized as a basis, the above pigments can be so far considered as excellently suitable for the examination of the soil. K. SCHARRER.

Electrometric Titration in its Significance for the Lime Requirement of our soils.

NIKLAS, H. and HOCK, A. *Landwirtschaftliche Versuchstationen*, 104,93, 1925.

For carrying out the electrometric titration 50 g. soil are shaken for half an hour with 125 ccm. 7.5 % KCl solution, then, after decanting, 10-20 ccm. are pipetted, and, with the help of the universal indicator recommended by the authors, the soil reaction is arrived at by the aid of an electrometer. Then the alteration of the actual acidity is traced, which is apparent if to the soil solution are added known quantities of acid or alkali, whereupon the number of ccs. of acid or alkali introduced are drawn on the abscissa, and the corresponding values for pH on the ordinate of a coordinate system, and the titration curves appertaining thereto are constructed. Most acid mineral soils, with electrometric titration, show their chloride of potassium extraction curves, which point to the presence of $AlCl_3$, consequently to changeable acidity, whereas forest soils show quite a different course of curve, because with them the acidity is caused by humus acids and phosphoric acid. When soil suspension methods are employed, the course of electrometric titration proceeds with difficulty; with sandy and light loamy soils it is successful, but with the heavy loamy and clayey soils, and with many humus soils, it is quite impossible in consequence of the poisoning of the electrodes by the soil colloids. If the total acid in a soil is ascertained by the DAIKUHARA method, using methylene red as indicator, then the quantities of lime calculated from that are certainly minimum values, and are mostly to be considered as insufficient, whereas by the DAIKUHARA method, using phenolphtalein as indicator, values result which are too high, whereby one dose of the amount of lime indicated as wanted might under certain circumstances be too much for many plants. The figures arrived at on the basis of electrometric titration for chemical neutrality lie between the two limits, and may be considered as serviceable results. K. SCHARRER.

On the Quantity and Chemical Composition of Colloidal Clay.

NOVAK, V. SMOLIK, L.: O mnozstsvi a chem. slozeni jilu Kolloidniho Zpravy.

The following is a summary:

1. Colloidal clay in its widest sense amounts to more than 9 % of the total mass of the soil.

2. The content in colloidal clay proper amounts to 7 % of the total mass of dry soil.

3. The ratios between SiO_2 and (Fe_2O_3, Al_2O_3) in colloidal clays, properly so called, varies between 2.5 and 1.04 : 1. The ratios between SiO_2 and Al_2O_3 run from 4.3 to 2.6 : 1.

4. The content of colloidal clays proper in alkaline and alkaline earth bases is generally relatively high.

5. The organic part of colloidal clay is generally more easily dissolved in a 10 % solution of hydrochloric acid than the inorganic part. Accordingly, it is thought that nutritive substances are more easily set free from organic combinations or complexes than from inorganic combinations.

6. It appears that the basis of colloidal clay in the wider sense is a pseudo-combination of humic matter with alumo-silicic acid. Colloidal clay proper is probably only composed of alumo-silicic acid. The absorbent power of colloidal clay proper, owing to the lesser surface activity of the inorganic colloids, is less considerable than that of clay in the wider sense. L. SMOLIK.

Researches on Nitrification and Denitrification in Oxidizing Media.

PARISI, E. (Istituto superiore agrario, Bologna). *Le Stazioni sperimentali agrarie italiane*, Vol. 58, No. 10-12, pp. 449-472, bibl. Modena 1925.

The nitrification of ammonia occurs regularly in an atmosphere of pure oxygen. This fact, which the writer has proved, enables the phenomenon of nitrification to be studied more intimately and furnishes the method of establishing a complete balance of nitrogen.

The author's experiments show that the combustion of organic matter, such as may be indicated by the production of carbon dioxide, is in proportion to the quantity of oxygen consumed. In permeable soils, then, ammoniacal nitrogen and nitrous nitrogen are completely transformed into nitrates, in an atmosphere containing oxygen; in waterlogged soils, on the other hand, especially in the presence of amino-acids or amides in sufficient quantity, ammonia and nitrous acid are readily broken down and their nitrogen is set free into the air in a molecular state. In such cases, the total decrease of nitrogen is equal to the weight of the nitrogen set free.

Very probably the group $>CHNH_2$ reacts on the nitrous acid according to the formula $> CHNH_2 + HNO_2 = CHOH + H_2O + N_2$, in this way causing a loss of nitrogen double that which would occur through simple denitrification. In a soil containing 15-20 % of water, the consumption of oxygen is more intense than in a waterlogged soil. The presence of sugar however can increase the consumption of oxygen in waterlogged soils to an extraordinary extent. A. F.

Is Soil Reaction of Importance for the practical Agriculturist ?

TRENEL, M. *Zeitschrift f. Pflanzenernährung und Düngung.* Vol. V, Sect. 4, Part B, 1926.

The work deals with the dependence of liveliness of growth of the different cultivated plants on the soil reaction. The reaction cards of the

estates examined are appended. It is shown that the determination of reaction by electrometrical methods in suspensions containing KCl shows this dependence better than do measurements in watery suspension.

Soil reaction more acid than pH 6.0 injures beetroot, barley and clover. Oats and wheat do well up to pH 5.2 ; potatoes were found insensible up to pH 4.2 ; with rye an optimum could not be recognized. Sorrel and equisetum cannot be considered as definite signs of soil acidity.

The geological conditions of the soil must be taken into account in judging. Referring to this, investigations of the sub-soil, which are given in the reaction cards, deal with this point and are of great value to the agriculturist. L. G.

Soil Biology.

Soil Sickness.

DE GILLIS H. (R. Stazione Chimico-Agraria Sperimentale di Portici). *Le Stazioni Sperimentali Agrarie Italiane*, Vol. LVIII. No. 10-12. p. 373-439, 1 Tab. Modena 1925.

In spite of the numerous investigations on the so-called sickness of he soil, the problem of its determining causes not only remains obscure but demands the recording of experimental researches, based on sure method and extending to the study of the phenomenon down to its characteristic beginnings.

The author has therefore initiated a plan of systematic researches with the object of solving this problem. In this, his preliminary note, he reports on the experiments made with mustard, peas and *Miagrum sativum*. The phenomenon of decreased production is sketched clearly in these researches ; in some cases there was an increase rather than a reduction of production, but these were quite isolated exceptions, after which the phenomenon renewed its normal course.

The process of sickness however is not found to be so quick as is generally allowed, though the plants selected were those considered best suited for the purpose. Undoubtedly then the phenomenon is subject to the action of external agents ; thus the summer season makes it more active. It is not possible at present to say whether this corresponds with a more active vegetative growth evolution or with other conditions.

Moreover the sickness exercises greater influence on germinating seeds and on plants in the first stage of growth and it is quite possible that the damage sustained then may be the principal cause of subsequent defects.

The writer proposes to follow up his researches by investigating the effect of aqueous extracts of the soil when it has reached the most suitable degree of sickness, if not of absolute unproductivity. A. F.

Humification Experiments.

CAUDA A. (Asti. R. Istituto Tecnico Gioberti). *Le Stazioni Sperimental Agrarie Italiane*, Vol. 59, No. 1-3, pp. 99-105. Modena, 1926.

The aptitude of agricultural soil for transforming cellulose into humus varies from one soil to another owing to the presence or absence of humifying bacteria and depends on its constitution and composition.

The author investigated this bacterial activity in various soil samples :— meadow soil, soil under willow trees, willow mould, plane tree mould, of which only the willow mould caused total humification of wheat straw and the fruit sheaths of maize.

The humification takes place at a high temperature (30°C.), with cold it slows down or is prevented. From other experiments the author deduces that ammonium sulphate also retards and hinders humification. Immersion in water prevents, while light does not hinder the formation of humus.

Coprinus and the bacterium of peat cause a noticeable transformation into humus ; the former gives rise to colonies of the appearance of paraffin, with development of ammonia, while a bacterium is isolated with colonies mostly white, red, yellow, brownish, capable of humifying straw with much blackening and giving off an earthy smell of beet.

We cannot speak of a true transformation into humus in the case of the ordinary mushroom or of fermented tobacco.

The Effect of Sulphur on the Microflora of the Soil.

FIFE, J. M. (Utah Agr. Exp. Station), *Soil Science*, Vol. XXI, pp. 245-252, 1926.

This is a report of a study made on the influence of varying amounts of sulphur on the soil microflora as measured by numbers, ammonification, nitrification, azofication and the rate at which the sulphur is oxidized to sulphates.

Three soils were used in the experiment. soil " A " with a low organic matter content, soil " B " with a high organic matter content and soil " C " with a medium organic matter content.

The sulphur applied ranged from 100 to 1000 pounds per acre.

According to the author sulphur greatly stimulated ammonification in all three soils with soil A leading. Nitrification was stimulated in soil B by sulphur in all concentrations with the exception of the highest applications. Sulphur was very toxic in soil A. Although the sulphur was very toxic at all the lower concentrations in soil C, a great stimulation occurred in the higher concentrations. The sulphur was without effect on azofication during the short time the soil was under observation. There was a general decrease in the number of bacteria over the period the counts were made in the treated and in the untreated soils. Soils A and C showed a very slight increase in bacterial numbers. J. S. JOFFE.

The Bacterial Types Occurring in Frozen Soil.

LOCHHEAD, A. G. (Central Exp. Farm, Ottawa, Canada) *Soil Science*, Vol. XXI, pp. 225-231. Baltimore, Md.

This is a report of an investigation on the bacterial types occurring in frozen soils of Eastern Canada. The field soils had been frozen for more than 2 months. The number of bacterial colonies appearing on albumin agar at 3° C was less than 10 % of those at 20°C, most of the bacteria of

frozen soils being incapable of low temperature growth. At 20° C the most abundant type was the group of non-sporulating short rods, non-liquefying or slowly liquefying, and the next most abundant group was that of *Actinomycetes*. Rapidly liquefying rods and micrococci were found to be numerically unimportant. At 3° the non liquefying short rods formed a higher proportion of the bacterial colonies, the other groups showing even less capability for low temperature growth than these forms. The microflora of frozen soils does not appear to exhibit characteristics different from those found at other seasons. Sixteen type species, isolated from nutrient agar plates at 3° have been described, as well as their frequency. Two types predominate — both non-sporulating short rods — one slowly liquefying, one non-liquefying, and they appear to be representative soil types of other seasons which develop better at more moderate temperatures.

J. S. JOFFE.

Handbook of the biophysical and biochemical Investigation of the Soil.

STOKLASA, J. in collaboration with DOERELL, E. G. With 91 text illus. pp. 812. Paul Parey, Berlin, 1926.

The book contains what the title promises. It is a work which recapitulates our present day knowledge in the field of biophysics and biochemistry of the soil, with a clear arrangement of the matter, a clear representation and full comprehension of the subject. Space forbids more than a short summary, which will suffice however to show that its comprehensive and enlightening account of soil problems is of the greatest scientific importance.

In the section on biophysical and biochemical examination of the soil the general methods of soil examination are first of all described, particularly the mechanical analysis of the soil and the determination of water capacity, also the analysis of the soil air. Further sections deal with its chemical analysis, the determination of the soil colloids, of its electrical conductivity and its catalytic agents. The section on soil reaction gives a comprehensive account of the numerous electrometric and colorimetric methods. There follows then the description of the special chemical examination of the soil, particularly of the determination of foodstuffs in soil extracts. Of especial interest is the next section on radioactivity in the soil and in the soil air, and its influence on the germination and development of plants.

The second main section of the book covers the methods of biological investigation of the soil. After general observations on the micro-organisms present in the soil, the bacteria of the rhizospheres are described, and the methods of the examination of edaphons demonstrated. After a comprehensive description of the bacteria taking part in the nitrogen cycle in nature, there come sections entitled : Synthesis of albumen in the soil, methane-decomposing and hydrogen-oxidizing bacteria, sulphur bacteria, desulphurizers, iron bacteria, actinomyces, soil fungi, soil algae, protozoa. There follows then a description of them. Determination of the results of bacterial respiration is then described, as are biological absorption, and biochemical

methods for determining the hydrated phosphoric acid and oxide of potassium contained in the soil in an assimilable state. The further chapters concern :— soil respiration, carbon dioxide as basic factor, methods for determining the carbon-dioxide produced by the soil, connection between organic substance and heterotrophes, between the chemical character of the organic matter and the respiration process, breaking up process of the cellulose in the soil, oxidization processes of the nitrogen-containing organic substances in the soil, respiration intensity of the micro-organisms, respiration of forest soils, composition of drainage water as an indication of the bio-chemical processes in the soil, effect of stable manure on the mechanics of the respiration process in the soil, influence of radioactivity on the dissimilation process of the micro-organisms in the soil. It is in short an outstanding work which should be in the library of all soil scientists.

SCHUCHT.

Soils and Vegetation.

The Significance of Traces of Elements upon the Growth of Young Orange Trees.

HAAS, A. R. C. and REED, H. S. Riverside, California, Citrus Exper. Station.

Characteristic injury to the foliage of young orange trees is often observed in sand culture experiments. The injury does not occur in sand cultures where tap water is employed in making the nutrient solutions, but is prominent where carefully distilled water and pure chemicals are employed. The difficulty is overcome by adding to the supposedly complete culture solutions minute amounts of a suspension containing aluminium sulphate, potassium iodide, titanium sulphate, potassium bromide, strontium nitrate, lithium nitrate, manganese sulphate, boric acid, and ammonium nitrate. It is improbable that all of these ions are necessary for alleviation of the difficulty, and future work is in progress to ascertain those which are essential. X.

Contribution to the Question of the Influence of Pure Spruce and Beech Stocks, as well as Mixed Stocks formed by both kinds of trees, on some qualities of Forest Soils.

KVAPIL, K. and NEMEC, A. (From the Biochemical Institute of the State Forest Testing Station at Prague). *Zeitschrift für Forst- und Jagdwesen*, year 57, pp. 193-231. With 11 tables, 3 diagrams and 2 illus.

The authors show, from a big series of physical, chemical and biochemical examinations of the same soil, that the influence of pure spruce stock on the sandy, primitive mountain loam of East Bohemia (in the forest part of Tremosnice near Caslau, height above sea level 420 m., average yearly temperature 8.4° C., annual precipitation 646 mm.) is much more unfavourable than that of pure beech stock. The favourable conditions induced by the latter were reached, or even surpassed, if beech and spruce were mixed.

Kopecky's suspension analysis shows that all three soils (at a depth of 35 cm.) maintain a normal and fairly similar condition.

But the fine sand content of the pure spruce soil is the greatest, amounting to 32.5 % by weight, which points to a more unfavourable physical condition of the soil.

Following BURGER's view that the air capacity is the most important indicator of the fruitfulness of forest soils, these are the only physical figures to be worked out, and are in absolute values: beech 22.37; spruce 15.00, mixed stock 26.73. These figures themselves suffice to show the unfavourable influence of the pure spruce stock, and the favourable influence of the pure beech and also of the mixed stock.

The *analysis of nutrient matter* (boiling the soil with 10 % Hydrochloric acid) gives a corresponding picture:

Table III. (*abbreviated*).

Kind of wood and type of soil	Content of nutrient matter in % of dry weight				Organic matter in %
	P_2O_5	K_2O	SO_3	CaO	
Beech, mineral soil	0.228	0.039	0.449	0.117	4.73
Spruce »	0.005	0.021	2.599	0.081	1.58
Both mixed »	0.144	0.047	2.699	0.187	4.89

Determinations of nitrogen were made by methods which I shall explain at another time for humus and mineral soils (surface layers). They were then separated and differentiated again into nitrogenous compounds, soluble in concentrated HCl such as amides and diamino-acids. The spruce humus most rich in total amount of nitrogen (1.473) contains it however in a very insoluble form, so that it only passes into the mineral soil to a small degree. These unfavourable food conditions for the trees, obtaining in woods of pure spruce, can be made just as favourable as those in pure beech woods by mixing spruce and beech, as the following figures show:— Beech humus 0.867 % N, beech mineral soil 0.231 % N., spruce humus 1.473 % N, spruce mineral soil 1.58 % N, mixed stock humus 1.269 % N, the like mineral soil 0.282 % N.

The *acidities* (total. relative to titration acidity, actual and exchangeable acidity) are such in their values that the spruce humus is most acid with 4.6 pH, and with 6.2 pH the mineral soil of the mixed stock is almost neutral. They were determined colorimetrically by MICHAELIS' method (indicators without buffers).

The *catalytic power* (action of catalysis) of the soils showed itself to be in the closest dependence on the degree of acidity, whilst the most acid was least capable of releasing oxygen from hydrogen peroxide.

The *ammonifying power* was also shewn to depend on the degree of acidity and the amount of organic matter present, Tests by Remy's method gave the following results:—

Spruce 19.42 mg.; beech 85.44 mg.; both mixed 75.33 mg. N. (10 g. humus overlying mineral soil and 100 cm. 1 % Witte peptone solution).

The values of the *assimilation of the atmospheric nitrogen* were in the same relationship in the humus beds of the three stocks as were the bio-chemical qualities investigated up to now, in that pure beech showed a recovery of nitrogen of 14.85 %, pure spruce only 11.6 %, and the mixed stock 39.2 %. The mineral soils, gave rather a different result. The mixed stock, with 49.5 %, was the best, then followed pure beech with 27.8 %, and the spruce even showed loss of nitrogen (denitrification).

The nitrate formation, determined by the VHAMOT-PRATT method by reduction of the nitrate into picric acid, is shewn by the following figures, according to which pure spruce again comes out most unfavourably:

From Table VIII.

1000 g. humus in relation to mg. nitrate (net value) yielded:
Beech humus 128.2; spruce 94.2; the two mixed 168.3
Beech soil 77.4; spruce 59.3; the two mixed 88.8

The *phosphoric acid adsorption* was shewn to be exactly proportional to the degree of acidity. The acid spruce humus could only retain 16.6 %, while the mineral soil of the mixed stock, on the other hand retained 74.10 %.

The *cellulose decomposition* is demonstrated by illustrations. According to that, the three humus layers are approximately alike in operation. The strips of filter paper are but little consumed. But in the mineral soils, on the contrary, the strips of paper pressed by the mixed-stock soil are almost completely decomposed, while those in the spruce soil are almost completely untouched.

The *fermentation intensity*, determined by ALBERT and LUTHER's method in Ivanoff vessels with quicksilver manometer, is likewise smallest (40 mm.) in pure spruce soil; in beech and mixed-stock soil on the other hand being three times as great.

The *measurement of the chemical light intensity* in bunsen Roscoe units by WIESNER and CIESLAR's method leads to the conclusion that each individual corona of the mixed stock absorbs a somewhat greater quantity of light than the corona of the pure beech and particularly of the pure spruce wood.

According to all the data, there appears to be no doubt that for the sandy original mountain loam investigated, and the climate and conditions mentioned, which occur so frequently, the mixed forest formed of leafy and needle woods influences the general condition of the soil more favourably than pure stocks, and very much more favourably than the pure spruce stock. The important bio-chemical factors of the soils, are affected most.

GROSSKOPF.

Regional Soil Science

The Vegetation of Switzerland.

BROCKMANN H. JEROSCH. First series, Part I, Der Boden. Rascher & Co. Zürich, January 1925,

Of this very important work of the well known botanist and geographer, the first part on the soil interests us the most. The author states

his intention clearly in the headings of both chapters :— I. " Attempt to define the soils of Switzerland " and 2. " Surface formations and soil conditions in their relationship to vegetation ".

It may be surprising that a geographer and botanist should be the first to give a survey of the kinds of soil occurring in Switzerland, and of their distribution. The reason lies in the very small attention paid in the Swiss colleges to pure soil science and in a noticeable absence until recently of systematic, geographical, scientific soil investigation. That under these circumstances the work under discussion was a bold venture is clear, and it is to be expected that in many respects, from the point of view of a soil expert, many deductions of the author must appear as somewhat hasty.

In the first chapter the author gives, by the aid of the (somewhat altered) scheme of LANG a survey of the climatic types of soil, and advances the statement that in Switzerland there must be almost all types of soil, from arid to ultra-humid. As arid soils the author understands places where, especially in the mountains, through the action of water, lime encrustments occur, or where, under overhanging rocks, in caves, etc., there are efflorescences of salt. Included as humid soils occurring in Switzerland are yellow brown and humus soils, and as ultra-humid soils, podsol soils. The soils in the high mountains are partly designated as frost soils.

The author emphasizes with reason that as a result of the geological youth of Switzerland, and also especially because of the continual metamorphosis through demolition and upheaval, there are still present immature or very slightly disintegrated soils. This explains the great importance of the mother rock, and there results, therefore, as a consequence of the geological multi-formation of the surfaces a mosaic of the most varied kinds and conditions of soil.

In the 2nd. chapter the " superficial forms and soil conditions in their relation to vegetation " are dealt with.

In the centre the last two glacierizations, with their erosive action (principally by water) and discharges (moraines and fluvio-glacial boulders) form the character of the soil. The soil is conceived climatically as brown earth, which in any case, through the mother rock, is of very varied kinds.

The soil of the Jura is represented as being very dependent on its geological origin, and a tendency towards the formation of brown earth is assumed.

It is clear that the Alps must exhibit the most extended variety of soils. With the lack of exact investigation, it is naturally very difficult to get an insight into the actual conditions. BROCKMANN, therefore, ventures " no longer to pass by such important matters without bringing them within the range of our consideration ".

Encrustments, as mentioned above, are comprehended as arid soil formations. In relatively dry valleys (Wallis, Schanfigg) the author expects the appearance of yellow soil, and sees, in the various places where loess occurs, soils which incline towards the formation of yellow soils. A study of the effect of the wind on soil formation in the Alps is certainly well justified.

Ultra-humid climate at great altitudes, and in the valleys with high precipitation, on the northern border of the Alps, leads to Podsol soil.

In conclusion, three short sections are devoted to the frost soils in places where no chemical disintegration can take place, and to the soil movement and minute life of the Alpine soils.

The " attempt " of BROCKMANN has given the soil expert a very stimulating work. Of technical soil literature only that of LANG, WIEGNER and Graf zu LEININGEN is quoted. Further literature appears to be unknown to the author (for example RAMANN, Soil formation and soil classification). There are no analyses at all. The author states many times, however, that " at many places only individual observations were made " and " there might be omissions " (p. 34 and p. 49).

We consider that in reality the soil formation in Switzerland possesses a more humid character than is generally assumed to-day. More or less certain formations of Podsol soils are not rare in the centre of the country (particularly on gravel and loess), as a number of recent observations and works satisfactorily prove (WIEGNER, JENNY, JENNY and BRAUN-BLANQUET, MEYER, SIEGRIST and GESSNER). If the work of BROCKMANN-JEROSCH stimulates to detailed investigations, it will certainly have rendered a great service. GESSNER.

On the Causes of the Displacement of the Coast Line.

CREMA, C. Spostamenti della linea di spiaggia presso Favazzina nel Golfo di Gioia. *Boll. del R. Ufficio geologico d'Italia*, Vol. I, No. 9, pp. 1-13, 1 map, 1 fig. Rome, 1925.

Between the stations of Bagnara and Favazzina on the Tyrrhenian coast railway a retrogression of the sea coast, formed in that locality by deposits of the Favazzina torrent, has been ascertained. As principal cause of this phenomenon is to be considered marine erosion no longer counterbalanced by fresh deposits of materials by the torrent, the latter having changed its habit in consequence of the earthquake of 1908.

No other action can presumably be invoked to explain it, not even gradual earth movement which sometimes helps to cause variations of the coast line, seeing that no authoritative observations admit of such taking place on the coast investigated, and also the action of such slow movements could not attain appreciable importance in face of the so much more energetic action of tidal waves. Such phenomena may always, as in the case under survey, develop great importance, but only when the littoral is of a rocky nature.

Such changes in proximity to the mouth of a stream should always be regarded as possible whenever it is desired to effect the regularization of catchment areas. A. F.

The Reclamatian of the Lower Friuli.

FERUGLIO, D. and FERUGLIO, E. (Staz. Chimico-agraria sper. di Udine). La zona delle risorgive del Basso Friuli fra " Tagliamento " e " Torre ". *An-*

nali della Stazione chimico-agraria sper. di Udine, Ser. III. Vol. I, pp. 1-479, II Tab., 4 maps, bibl. Udine, 1925.

The vast zone which the writers deal with in this geological, hydrological, and agricultural paper comprises fifteen thousand hectares of land situated in the centre of the Friulian plain, for the greater part swampy and everywhere under difficult drainage conditions The soils have a diversity of texture and composition, but are almost always covered over by a considerable humiferous layer and variously clothed with self sown marshy and shrubby vegetation.

Few efforts have as yet been made by private agriculturists to free their property from the curse of these spring waters, which if suitably controlled and adapted to irrigation would, owing to their very excellent temperature and composition, actually tend greatly to increase the agricultural value of the land.

The reclamation of this zone is evidently beyond the power of private initiative and can only be expected to be undertaken as a public enterprise.

In the region investigated, from the point of view of reclamation, three zones may be distinguished :— An upper zone which includes the perimeter of the springs, in which the importance of the overflowing from the artesian strata is considerable; an intermediate dry zone, such as can succeed with a rational arrangement of drainage ; a lower circum-lagunary and delta zone, for the most part still marshy.

Provisions contemplating the mechanical raising of the drainage water are only necessary for the third zone. In the first and third zones there is absolute predominance of marshy growth, while in the second zone cultivated fields, more or less dry meadows and wooded areas prevail, the last of which however have to a great extent disappeared. The regularization should primarily be directed to the streams which collect most of the water into the irrigation channels of the springs so that the great masses waiting for dispersion of the side rivers (Tagliamento and Torre) may be promptly collected and got rid of.

Other essential works should be completed so that on the one hand the main streams and the torrential water courses may no longer form an obstacle or a danger to subsequent operations of agrarian reclamation, and on the other hand a sufficient quantity of irrigation water may be supplied.

Then considering the considerable extent of the zone represented by gravelly-sandy alluvia, with little natural fertility, ground elevated from the important superficial accumulation of humus, it is understood that a simple drying process of the land would undoubtedly lead to a great decrease in production. The zone would therefore be transformed into an area needing irrigation and for this purpose the considerable power of the overflow from the water holding strata in the upper zone is such as to assure any increase in consumption.

In the circum-lagunary zone the irrigation water would also serve very well for removing salt from the soil.

Agricultural improvement should go therefore hand in hand with these

water schemes and the technical agricultural programme should be based on the irrigation schemes. Water meadows and grasslands, cattle breeding, dairying, the cultivation of osiers, poplars, alders and, in process of time, the erection of human habitations in the hitherto unpopulated zone may be expected. The work will be facilitated by the fact that, under a recent ruling, the zone investigated is comprised in the first category of lands for reclamation. A. F.

Soil Formation, Colonization and Succession of Plant Associations on the Aar Terraces.

GESSNER, H and SIEGRIST, R. *Mitt. der Aargauischen Naturforschenden Gesellschaft.* Vol. 7, pp. 54, 1925.

The authors examined the meadows of the Aar Valley at different heights in the neighbourhood of Aarau in the Centre of Switzerland. The results of the soil examinations are given briefly:

A) In the so-called *high water channels*, the districts of the real river bed, the recent deposits (sand and gravel freshly washed out by high water) show a high but evenly distributed content of lime with on the average 25 % of $CaCO_3$. Also the humus content of this sand, poor in vegetation, is remarkably high (4 ± 0.4 %). On passing over to the fertile forest land, the humus content rises in the uppermost layer to 8 %. A slight washing out of lime is already confirmed here. Soil reaction neutral to weak alkaline.

B) *The lower terraces.* — Result of the last ice period, bears mixed woodland. Corresponding to the great age of this stage, the disintegrating progress of the soil in a humid climate is here plainly shown. The beginning of podsol formation is demonstrable by muriatic acid extractions, complete washing out of carbonates up to 1.2-1.8 m. deep, distinct washing out of sesqui-oxides and increase of the same in the lower lime free layers Reaction weakly acid, humus content up to 22.4 %.

C) *High terrace.* — Result of the ice period prior to the last. On account of the great age of these deposits, the formation of podsol soil is more sharply marked, and can be confirmed by the naked eye (photo). The upper levels of the soil are perfectly free from lime, and have a strong acid reaction (pH up to 4.9). The humus content falls with increasing depth, the subsoil being rich in $CaCO_3$. Unfortunately, only the podsol layer is sufficiently analysed.

Many tables, drawings and photographs make the work very clear. It must be given credit for first emphatically drawing attention to podsol formation in Central Switzerland. H. J.

The Diamond fields of South West Africa.

KAISER, E. Die Diamantenwüste Südwest-Afrikas. Explanation of a special geological map of the southern diamond fields 1 : 25 000, drawn up by W. BEETS and E. KAISER. 2 volumes with many tables, maps and illustrations. Dietrich Reiner (Ernst Vohsen) Berlin, 1926.

Seven years after the loss of the South West African protectorate a work has appeared which represents, scientifically, the most important

production emanating from this field of labour. Whilst PASSARGE's ehxaustive work on the Calahary only touches the eastern portion of the former colony, and SCHULTZE's able work "Aus Namaland und Kalahari", along with a general description of the country, plunges into an affectionate consideration of the natives, we have here before us a work which, starting from the interesting coastal deserts of South West Africa, collects there fruitful detailed results, and makes use of them for far-reaching conclusions with respect to the waste districts of other parts of the earth.

It is impossible, within the limits of a short description, to do justice to all the details of this exhaustive work, nor can the numerous individual contributions be gone into, which have been made to it by BEETZ, BOEHM, MARTIN, WAUFF, STORZ, STROMER, WEISSERMEL, WENZ, and WILLMANN. They go deeply into the results obtained by investigating special geological, paleontological and petrographical questions. The sections written by BEETZ are closely connected with the investigations of KAISER, so that they must be considered in conjunction with them.

Diamonds were discovered in the year 1908 in the most desert parts of South West Africa. The discovery soon proved itself much more important than was at first supposed, and gave rise to the founding of several diamond companies. The most important of these was the German diamond company, to which belonged the extensive diamond district south of the Lüderitzbuchst railway. That this monumental work has been made possible is mainly due to the former Director of this Company, Dr. HEINRICH LOTZ, who made it possible to send Professor KAISER, and was able to provide special sums for the carrying out of the work.

The whole work is based on the geological map on a scale of 1 : 25000, which was drawn up by KAISER and BEETZ. It is in 7 sheets, included in the first volume of the work, and even on the desk, in its special representation, permits a glance into one of the most interesting waste regions of the earth. The importance of the work, however, goes far beyond the explanation of the special geological maps, and gives in particular the picture of the origin of the desert. In the first volume, after a short survey of the geology, the structure of the old mountains of the primary formation of South Africa is given. The primary formation consists of gneiss, mica schists and chlorite schists. There also appears granite-gneiss, which is metamorphosed from younger granite, also veins of these granite injections, and converted basic rocks of volcanic origin.

Above the primary formation lie the Concip and Nama formations B. dealt with by BEETZ. As a result of extensive travel in the interior of South West Africa, it was possible to parallel these old fossile-free sedimentary layers with the formations in the interior already arranged earlier by RANGE; in consequence of the special mapping of the desert regions, the Nama formation in particular could be here drawn up in detail. Even in these oldest sedimentary formations numerous volcanic rocks appear. Whilst in the older crystalline foundation mountains acid volcanic rocks are most prominent, basic rocks predominate in the suspensory stage of the primary formation and the Concip formation. In part

these volcanic rocks possess great geological age, in opposition to the alkali rocks and allied rocks, which did not arise until during a jurassic-cretaceous levelling period, which followed the levelling of those formations. These alkali-syenitic rocks were specially examined and described in the Granitberg and in the Klinkhardtgebirge. On these levelling surfaces the old layers were then deposited in younger eocene and miocene forms, as described by BEETZ at the beginning of the second volume. In these layers were found, amongst other things, interesting remains of vertebrates which STROMER von REICHENBERG has described thoroughly. These throw new light on the geological past of South Africa. In the tertiary deposits we already find diamonds, which then, by working up, have in part undergone such enrichment that they represent the richest diamond appearance of the whole region. The primary beds whence the diamonds originate must therefore be older than eocene, and approach very nearly to the age at which the South African geologists place the upper lime of Kimberley. KAISER and BEETZ come to the opinion that neither dark blue beds under the sea, nor the Orange River, nor the Benguela come into question as conveyors of the diamonds; the origin of the diamonds must rather be sought inland in South West Africa under the deposits of the dry climate. The dry flows of the oldest tertiary time have in their course carried to the coast the diamonds washed out of the mother rock, and bedded them in the layers deposited by them. There, where the eocene sea has spread out the layers, or the lower miocene rivers have washed them out, they appear in a richer state. The richest beds have been blown out of this deposit again by the wind.

These isolated samples of the work must suffice to show the special results of the two investigators.

The other great undertaking which KAISER has set himself is to follow up all the factors of the desert formation in their relation to each other. So he shows us in a masterly way the processes of the mechanical rock preparation and rock deposit in a dry climate. Water and wind are dealt with thoroughly. It is shown how far-reaching are the effects of water even in the dryest parts of the desert, where they would be least expected, and where many investigators have spoken of a purely mechanical rock preparation. Attention is also drawn to the importance of the wind, for which this wind-ravaged part of the coastal deserts is particularly notorious. The investigations on the re-deposit of silicic acid are also of very great importance. Their elimination again takes place in the coastal districts in greater proximity to the source of origin than in a humid climate. Nearly all the rocks are silicated. Under new formations of silicic acid formation are understood all the processes which play a part in and after penetration of the silicic acid coming from outside into the mineral residues present. The carbonate rocks of the Nama formation in particular present a good field of reaction for the silicic acid. Also the tertiary Pomona quartz and the surface lime are strongly silicated. The silicification processes are extended over a long period of time, beginning with the chalk period. An optimum is given by the passing over from normal arid to extreme arid climate. For the formation of a strong si-

licated covering, a long maintenance of the form of the upper surface of the land is necessary. Of the young, sedimentary, new formations in the desert climate, the wind borne sands are thoroughly dealt with. The appearance of these is different in sand drift and sickle shaped dunes. Both are streamline bodies, but of quite different form and origin.

The work is beautifully got up. Two coloured title illustrations after pastels of the well known South African painter AXEL ERIKSON give a picture of the beautiful colours of the desert. 54 tables explain the landscape and geological profiles, indicate the morphogenetic processes, and again give the fossils dealt with. 32 stereo-illustrations make possible a glance at the small forms of the desert. Numerous text illustrations explain the text. The special geological maps are supplemented with maps of the Granitberg, a morphological map of the Wannen country, and one of a journey amongst the dunes. The price for the beautiful work is put low, its appearance being made possible by contributions to the costs of printing which were granted to the publisher. RANGE.

The Composition of the Fractions Separated by Mechanical Analysis from some Transvaal soils.

MARCHAND, B. de C. and van der MERWE, C. R. *South African Journal of Science*, Vol. XXII, pp. 104-118. Johannesburg, 1925.

A brief review of the literature on the above subject, outside South Africa, is given and then the mechanical analysis and the chemical composition of the various fractions discussed of (*a*) sandy soil types and (*b*) heavy soils. The mechanical analysis is done according to the (HALL) beaker method and the soil separated into seven fractions.

Typical mechanical analysis of sandy soils from four different rock formations are given as well as the ultimate chemical analysis of each fraction. The silica decreases while the alumina, iron oxide and phosphoric oxide increase, as the size of the particles decreases. The phosphoric oxide is concentrated to a great extent in the clay fraction. Lime, magnesia and potash also increase as the size of the particles diminishes up to the very fine silt fraction which usually contains more of these constituents than the clay. In sandy soils derived from granite, the coarse fractions, however, show a higher percentage of potash than the finer fractions.

With regard to the heavy soils, the heavy red loams and the black clay soils (turf soils) are taken as samples.

With the heavy red loams (derived from ferruginous, basic igneous rocks) the silica decreases regularly and alumina, magnesia, and phosphoric oxide increase generally as the size of the particles decreases. The potash shows considerable irregularity, but the finer fractions as a rule are richer in that constituent than the coarser ones. Since these soils have a high clay percentage (40-50), the phosphoric acid and also potash are largely concentrated in the clay fraction.

The black clay soils are also derived from basic igneous rocks (see MARCHAND: "The origin of the black turf soils of the Transvaal" this Review, Vol. IV, No. 3, page 6, 7), and contain a varying amount of free calcium

carbonate. Silica and lime decrease, as a rule, as the particles decrease in size. The general tendency is for the alumina, iron oxide, magnesia, potash and phosphoric oxide to increase from the coarser to the finer soil fractions, with slight irregularities here and there.

In conclusion the physical properties and the composition of the clay fractions of the above two types of heavy loams (red and black) are compared and the very marked differences discussed. MALHERBE.

Seasonal Variation in Salinity of Nile Water at Rodah (Giza) with Special Reference to Alkaline Carbonates.

ALADJEM, R. *Technical and Scientific Service Bulletin*, No. 69. Ministry of Agriculture, Egypt.

Chemical research on Nile water has been made since 1812 by several writers, but until the recent work of M. Victor MOSSERI no attention had been paid to alkaline carbonates and the resulting alkalinity of Nile water at certain periods of the year.

The writer's researches which were carried on for two years (1924 and 1925) have dealt with samples of water taken weekly from the Nile, below the Rodah bridge, at a depth of 2 metres.

The total amount in solution, the alkaline carbonates, the total bicar bonates and the chlorides have been determined. The WINKLER-CAMERON method, inaugurated in Egypt by M. V. MOSSERI, has enabled the bicarbonates and the soluble carbonates to be separately determined.

From tables and diagrams drawn up by the writer it is shewn that the salinity of the Nile is at its maximum when the river is at its lowest, and that the bicarbonates form the most important fraction of the soluble total.

The origin of this alkalinity should be sought in the White Nile, being the result, according to all evidence, of the evaporation of the water which reduces the alkaline bicarbonates to carbonates. This change occurs either during the flow of the water of Lake Albert to Assouan, or in the reservoir of Assouan itself.

The waters of the White Nile are themselves enriched in alkaline carbonates by the Bahr el Gebel, which, during its passage through the Sudd, loses about half of its volume of water by evaporation.

Moreover, the waters of Lake Albert, of which some samples supplied by Dr. HURST have been analysed by the writer, are very rich in bicarbonates and contain a relatively high proportion of alkaline carbonates; but these waters do not appear to contribute to the alkalinity of the White Nile.

Most of the dissolved matter contained in Nile water is formed of bicarbonates, especially bicarbonates of magnesium and calcium.

The quantity of chlorides is very small, the maximum (47 parts per million expressed as NaCl) taking place at low water in May. The chlorides become appreciable, not only in consequence of the concentration of the Nile water at that period, but also because, like the bicarbonates, they are brought in by subterranean water which is discharged into the river.

Alkalis only form a small fraction of the dissolved matter in Nile water, which confirms previous researches of M. Victor MOSSERI, and the writer shows that this water contains in solution more lime and magnesia than potash and soda. If this had not been the case Egyptian lands would long ago have become sterile. V. M. M.

Carbonates and Bicarbonates in Solution in Nile Water.

MOSSERI, V. M. Bull. Inst. of Egypt. 1925.

The presence in irrigation water of alkaline carbonates and especially of sodium carbonate beyond a certain, always very small, percentage is objectionable. What matters most is the nature of the salts remaining after the evaporation or absorption of the irrigation water.

Though the Nile water and the subterranean waters do not ever contain dangerous proportions of alkaline carbonates, they have on the other hand appreciable quantities of bicarbonates, among others alkaline bicarbonates, which sometimes are transformed into very harmful alkaline carbonates.

The composition of the matter in solution in Nile water had only hitherto formed the subject of fragmentary and incomplete researches; the writer is the first person to make a systematic study of the question and to make separate determinations of the carbonates and bicarbonates, which he has done by means of the WINKLER-CAMERON method .

These determinations, started in 1906 on irrigation and drainage water as well as on subterranean water, have been made regularly since 20 April 1924 on the waters of the Nile itself, being taken every 7 days at a depth of 2 metres at two different places of the river at the Cairo level.

Besides carbonic acid of the carbonates and bicarbonates, the writer determined the total soluble content and the chlorine, and estimated the total CO_3 of the carbonates and bicarbonates. These data expressed on the one hand in milligrammes per litre and on the other in percentages of the soluble total have been condensed into two tables and compared with the approximate discharge of the river above the Delta dam.

It appears from these figures that the alkaline carbonates (and silicates) are most abundant (6 to 11 milligrammes per litre expressed as CO_3) during the last three months of low water (May, June, July) : the alkaline reaction with phenolphthalein is then appreciable ; while it is scarcely perceptible during the rest of the year and becomes nil from the middle of November to the end of January.

The bicarbonates are present throughout the year ; their quantity, expressed in HCO_3 and in milligrammes per litre, varies from 98 to 159 with a maximum in June and July and a minimum from September to December.

The fluctuations of the bicarbonates as well as those of the total of carbonates and bicarbonates (total CO_3) are similar to the variations of the chlorides, except in May and June. The quantity of various elements, expressed in percentages of the total soluble content, show that, expressed in CO_3, the alkaline carbonates (and the silicates) represent 0 to 5.5 %, the

bicarbonates 55 to 44 %, the total of carbonates and bicarbonates 36 to 45 % of the total soluble content.

The writer, after having pointed out that in order to discuss these results usefully the quantity of silicates must be determined as well as the nature and the proportion of the various bases present in the Nile water at different periods of the year, insists on the importance of this question, which should not be lost sight of in works for regulating the river.

V. M. M.

The Fertility of Egypt.

MOSSERI, V. M. *Comptes Rendus du Congrès International de Géographie du Caire*, Vol. IV, pp. 135-168.

In the first part of his paper the writer deals with the agricultural wealth of Egypt and its principal factors, namely :— geographical position, climate, the peculiar character of the peasants, the soil and the river which waters it.

The remarkable geographical position of Egypt has had the most fortunate results on its commerce, supported almost exclusively, so far as exports are concerned, by agricultural produce, and on its flora, of which numerous representatives especially most of the plants cultivated at the present time are of foreign origin.

As the writer remarks, the history of the botanical acquisitions made by Egypt in the course of centuries is not only the history of its agriculture but also that of its external relations. According to SCHWEINFURTH, that history is divided into six periods, in the course of which Egypt borrowed much from tropical Africa, Arabia, Babylonia, Persia and India, Syria and Armenia, the Balkan Peninsula and more recently from America, thus collecting in its midst, thanks to the fortunate combination of the soil conditions, climate and irrigation, the greater part of the agricultural flora of the world. Recent attempts at new introductions have also been fortunate.

The climate of Egypt, regular, free from injurious extremes and from excessive dryness allows of the production of superior cottons in the Delta, cultivation of maize in Lower and Middle Egypt and of bersim, the most valuable of the Egyptian leguminous crops, from Assouan to the Mediterranean.

Although uniform as a whole it has however sufficiently marked differences between the south and north to impose on the agriculturist some discretion in the choice not only of the species but also of the varieties to be grown. It is thus that the growth of fine cottons is the speciality of Lower Egypt, that Upper Egypt, where coarse cottons are produced, is preeminently the region of the sugar cane for industrial use, of sorghum, onions, lentils and even of the bean ; that maize is uncommon outside Lower and Middle Egypt ; that rice, dinebe and samara are reclamation crops confined to Lower Egypt and the Fayoum.

After having sketched the character of the Egyptian fellah, whose aptitude is remarkable, and indicated the measures which should be taken to safeguard the qualities and health of rural labour, one of the principal fac-

tors of the prosperity of the country, the writer deals with the investigation of the soil of Egypt and the Nile. The genesis of these soils and the investigation of the Nile water are here related, as they have already been at greater length by the writer in previous publications (notably in " Agrological notes on the Egyptian Soil "). In the second part, the writer examines the conditions which in former times, under the regime of irrigation by basin, assured the maintenance of the fertility of the Egyptian soil; he passes in review, as he had already done in a previous publication (" On the Egyptian soil under the regime of irrigation by inundation "), the many benefits of the fallow period, called *sharaqi*, the suppression of which under the present irrigation system is very harmful.

V. M. M.

Contribution to the Characterization of Soils of Hanâ, Czecho-Slovakia.

NOVÁK, V. Prispevek Kcharakteristice pud. Hané. *Zpràv vyzkumnych ustavu zemedskych c.* 3 *Ministersivo zemedelstvi Prague* 1925.

This essay is a preliminary study of the typical soils of Hanâ. Hanâ is the flat country of Central Moravia, celebrated for its crops of malting barley. The general characteristics and the climatic seasons of this country are first of all described. The description of three sections of the soil of the following places :— Ivanovice, St. Ves near Prerov, and Hulin is given. The characteristics of the soil profiles are given by mechanical and chemical analyses.

The soils investigated are all " tchernozion " black soils slightly degraded. These black soils appear in two variations. The Ivanovice profile shows black soil with a tinge of brown — this is the soil of the drier places — with a layer of humus of a maximum depth of 70 cm., while the St. Ves and Hulin profiles show a darker, black soil, — this is the soil of the moister places with a layer of humus of a greater depth than 70 cm.

L. SMOLIK.

The technical investigation of the soil of the fields of the Agricultural School at Zhar in Moravia, and the immediate neighbourhood.

NOVÁK V., HRDINA J., and SMOLÍK J. Půdoznalecký prozkum pozemků hospodařské školy na Moravě a přilehlého okolí, Sborník vyzkumných ústavů zemědlěshých, sv. 14. *Ministerstvo zemědělství*. Prague, 1925.

The soil is that of a crystalline schist area. The Land Investigation Station at Brünn utilizes a large portion of the school fields for plant investigation. About 200 ha. were examined in detail. The summary of the investigation is seen graphically on the coloured map (scale 1 : 5000).

The soils are grouped as follows according to their genetic relationship.

1. Holocene meadow soils, 2. Podsol soils on diluvial drifts. 3) Podsol soils on gneiss detritus. 4) Podsol soils on diluvial deposits. 5) Podsol soils on disintegrated gneiss.

Further differentiation of these soils was carried out according to texture. On the average, the texture of the field mould was as follows :

Size of grain — mm.	Contents — %
0.01	40 - 45
0.01 - 0.05	20 - 25
0.05 - 2.00	40 - 30

A great lack of lime and of assimilated potash was determined by NEUBAUER'S method. L. SMOLIK.

Agricultural Importance of the Tocra District.

SCARTA, H. (R. Uff. Agrario della Cirenaica). *Rapporti e monografie coloniali del Governo della Cirenaica.* Series I, No. 7, 18 Tab., 1 Map. Bengasi, 1924.

From an agricultural point of view the soils of the Tocra district may be divided into argillaceous-sandy soils (along the littoral strip from Tocra to Bersis), fairly deep (even over 3 metres), with rocky subsoil (calcareous bed which forms its foundation) ; there are also soils of conglomerate type containing river-borne pebbles and rubble of superficial erosion.

Judging from appearances, they are fertile soils with high hygroscopic power ; this may be presumed with greater reason from the fact that they are soils formed of thousand years old deposits of mud brought down annually by floods.

The various alluvial strata which cover the calcareous bed have different depths at different points.

Considerably different in appearance are the soils in proximity to the Sebka, being composed of the finer elements of the alluvium : dusty in summer, swampy in winter, they have visible saline efflorescences which may become regular crystallisations. The saline concentration decreases gradually as one gets further from the lake basin of the Sebka. The approximate extent of economic territory considered by the writer is about 250 sq. km., of which about 85 % is utilizable for pastures, which are grazed at different seasons according to their position, and a proportion of 15-25 % utilized or utilizable for the growth of cereals.

The population of the Tocra hinterland may be calculated at 2952 souls, with a total of 30 904 head of cattle over a pasture area of 21 200 ha. The area cultivated under cereals varies very much from year to year according to the rainfall. In 1922-23, a year of copious and regular rainfall, it was 3720 ha., in the following year, a year of very irregular rainfall, it was only 85 ha.

The area made fit for irrigable cultivation is 158 ha. of which only 41 ha. are permanently cultivated ; the population which lives on and works this area is about 1/80th of the total population.

The growth of fruit trees represents a secondary item of income and the garden is more or less the result of the particular soil conditions and the social needs of the Kabyles and has become a factor of equilibrium and se-

curity against the sudden fluctuations of cereal and pastoral production.

There is some land which might well be irrigated, a total of 810 ha. forming a basis for the future increase in value of the zone.

There are too other lands which may be considered as subsidiary to the irrigable lands, and another 10 000 ha. of good land, with good depth and quality of soil, on gentle slopes, part of it benefited by winter floods.

No progress from the present form of misuse of the soil can be expectted from the indigenous population. Admitting the possibility of cultivating garden crops, part for local consumption and part susceptible of foreign and industrial trade, the establishment of a nucleus of a white population of about 2500 persons, to the extent of 5 per hectare, inclusive of white labour is considered possible.

Other groups might be established elsewhere with a total of 3500 for the land made fit for irrigable cultivation and about 7000 for ordinary dry cultivation, of whom not more than 3000 would be in Tocra and the others in rural villages scattered along the water places of Sabal.

The realization of this scheme, modest as it is, requires however shrewdness in the acquisition of land and in the investment of capital for irrigation and in general for economic reclamation. A. F.

On the meadows of the Tessin River. Study on the Connection of Soil Formation and the Succession of Plant Associations.

SIEGRIST R. and GESSNER H. Festschrift Carl Schöder. *Veröffentlichung des geobotanischen Institutes Rübel* in Zürich. Part 3. Rascher & Co. Zürich, 1925.

We heartily welcome this collaboration of botanists and soil experts. The present work shows very plainly how very closely soil formation and vegetation are connected with each other.

The investigation extends over the bottom of the valley of the Tessin from Airolo to Lake Maggiore. In the upper valley of the river the alluvial areas are only about 200 m. wide, whereas in the lower valley plains 10 km. long and 800 m. wide are quite covered with fertile woods and undergrowth. The following are the most interesting points for soil science.

All the soils examined belong to the brown earth type; the appearances of disintegration point to podsol soils, but these could nowhere be establised definitely. The unitary nature of the original deposits is shown by microscopic examination of the mineral composition of the sand. The new soils are bright grey, the more disintegrated older terraces showing pronounced chocolate-brown colouring, caused by humus and hydrate of iron. Analyses in muriatic acid extracts determined lime, humus and pH, ratio and suspension analyses gave the following picture of the soils: carbonate contents up to 12 %, humus contents up to 28 %. The very coarse sandy passage soils become very much richer in humus with progressive vegetation. Pronounced lime (and distinct magnesium) washing out is characteristic. The soils are found to be suitable for cropping, and quick cultivation of the meadows is recommended, to prevent the climatic washing away of its nutrient matter. H. J.

Sketch of Agricultural Geology of the Jura.

SIMONOT, F. *Le Jura Agricole*, 320 pages. Lons-le-Saunier, 1925.

We will confine ourselves here to the nature of the soils furnished by the different geological features of the Department of the Jura.

The generally marly soils of the Lias contain 4 to 15 % of lime, 2 to 3 % of phosphoric acid, and as much potash or nitrogen. They are very fertile.

The ferruginous limestone of Bajocien only yields on the surface soils containing traces of carbonate of lime, 2 to 3 per thousand of potash, and less of phosphoric acid and nitrogen.

The soils derived from the oolitic Bathonian limestones are chemically poorer. Carbonate of lime re-appeared on the analysis of the marly features. All soils of the middle and upper Jurassic are poor in phosphoric acid and contain less than 8 per cent of lime.

Lime content falls until there are only traces in the soils derived from yellow limestones, sands or the jagged face of the lower Cretaceus without the content in phosphoric acid being increased. The Pliocene soils of La Bresse do not contain any carbonate of lime and little phosphoric acid (0.5 to 1). The same is the case with ancient and glacial alluvial soils. The latter however are moderately rich in phosphorus, potash and nitrogen.

The richness of modern alluvial soils is very variable. In them the content in lime varies from zero to 20 per cent. The characteristic of Jura districts, where calcareous rocks predominate, is therefore the decalcification of the agricultural soils.

In view of the altitude of the mountainous part and the heavy rainfall, these lands are naturally suited for grass if they are marly and for forest if they are rocky.

Differing from dried regions showing the same features, Burgundy on the one hand and Provence on the other, which breed sheep, the Jura watered by 150 cm. of water goes in for the breeding of milch cows and manufacture of cheese.

The marls of the Trias and Lias exposed to the sun on the slope of the mountain are rich in phosphoric acid and potash and carry vineyards. Their content of carbonate of lime being less than 20 per cent., Riparia and Rupestris hybrids are used as grafting stock. The altitude of the vineyards is from 250 to 500 metres. Dr. PIERRE LARUE.

On the Exchange and Active Reaction Figures of Some Moravian Soils.

SMOLIK L. O výménných a aktivních reakóních číslech některých Moravských půd.

1. The following limits of exchange reaction figures in the Moravian soils were determined in pH :

(*a*) With cultivated soils 4.4 - 7.4 ;
(*b*) With forest soils 4.1 - 6.3.

Limits of active pH concentration :

(*a*) Cultivated soils 6. 3- 7.3 ;
(*b*) Forest and meadow soils 5.9 - 7.1.

The alkalinity of the soils fluctuates within limits not so wide as the acidity.

2. The greatest acidity (of smallest exchange and active pH concentration and at the same time the greatest titration acidity) was found in forest soils and in those cultivated soils only which came from the more humid climate (from 700 mm. upwards).

The profiles of the arid cultivated soils show neutral or weak alkaline reaction up to pH 7.3.

3. The profiles of the degraded black soil (e. g. Hulín) showed an approximately constant pH exchange reaction in the vertical direction. The argillaceous earth capable of exchange could not be established here (as with the majority of the arid soils); on the other hand lime capable of exchange occurred in the whole profile in considerable and constant quantity. The active pH concentration has a maximum in loose vegetable mould, a second in the deepest subsoil.

4. In all acid soils the presence of exchangeable argillaceous soil was established.

5. The titration acidity (n KCl) reached the following amounts (calculated to 100 g. dry soil):

(*a*) with cultivated soils, highest 3.927 mg H;

(*b*) with forest soils, highest 5.841 mg H; in water extraction 0.451 mg H.

6. There was no connection established between the weight of humus present and the pH concentration, though the soil samples whose humus was unsaturated (soils of more humid climate) showed everywhere a lower pH concentration.

7. In the laboratory test, the germinating capacity and average growth of barley showed no correlation with the different pH concentration (exchange and active) of the different soils on which the grains were grown.

8. The relation between the hydrogen-peroxide-catalysis of the soils and the exchange reaction figure in pH is only a partial one.

AUTHOR.

The Reaction Profile of some Old Valley filling Soils.

STEPHENSON, R. E. Soil Department Oregon Agricultural Experiment Station. Cornwallis.

Eight soils are studied to determine changes in hydrogen ion concentration, lime requirement, and replaceable calcium and magnesium with the development of a soil profile. Textural observations noted a marked concentration of colloidal clay material in the second major horizon in some of the soils studied. Replaceable calcium is usually much greater in amount in the heavy horizon than in either the surface soil or the parent material. In these cases acidity is greatest in the surface leached soil.

The development of a normal mature profile in the valley soils therefore appears to be accompanied by the formation of base poor, acid surface soil. The material from which the soil was formed, however, is usually

somewhat acid in reaction. The most fertile soils appear to carry the largest amount of replaceable calcium. Some of the soils which carry a fair amount of calcium in replaceable form are not productive however, apparently because of the physical conditions. X.

Relation of Replaceable Bases to Oregon Soil Problems.

STEPHENSON. R. E. Soils Department Oregon Agricultural Experiment Station. Cornwallis.

Replaceable bases are studied in eleven different Oregon soils taken from three types of climatic conditions. Six soils are taken from the humid valley section, two from the dry farm section and three from the arid section.

The soils from the humid area are heavy soil types acid in reaction, and much lower in total replaceable bases than soils from the dry farm section. One acid soil which responds abundantly to lime treatments in the field is very low in total replaceable bases, but especially low in replaceable calcium and high in replaceable hydrogen. The soils from the dry farm area are neutral in reaction, also rather heavy types, and very high in total replaceable bases and especially high in replaceable calcium. The soils from the arid section are neutral or only slightly alkaline light textured types. These soils are relatively low in replaceable bases, but show a high ratio of calcium to other bases.

There appears to be some correlation between total replaceable base and soil texture, as the heavier soils contain larger amounts when of similar reaction.

Calcium appears to be the most important replaceable base in both amount and function. Under humid conditions replacement of calcium by hydrogen produces base poor, acid soils. Under conditions of insufficient rainfall, calcium may be replaced by sodium, which results ultimately in alkali soils that are non-productive. In both cases prevention is decidedly better than cure. Proper soil management supplemented if necessary by treatment with special substances for its improvement may largely prevent either seriously acid or alkaline soils. At present there is no practical method known for reclaiming bad alkali soil. X

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Kíspatíc. — On the 17th May 1926, at Zagreb, the death occurred after long suffering of Dr. phil. MIJO KISPATIC, Professor in ordinary of mineralogy and petrography at the University of Zagreb, member of the Southern Slav Academy of Science, who had been living in retirement since 1918.

In addition to numerous scientific works which appeared in the " Rad der Südslawischen Akademie der Wissenschaft ", in the " Verhandlungen der K. K. geologischen Reichsanstalt ", in the " Centralblatt für Mineralogie ", etc., KÍSPATÍC was also the author, in the Croatian language, of a series of scientific nature instruction books, of which " Zemljoznanstvo, Zagreb 1877 " may be specially mentioned, as it represents the first technical instruction book on soil written in one of the Southern Slav languages. A. S.

Christensen. — On the 27th. August 1926 the death occurred of Dr. HARALD R. CHRISTENSEN, Director of the Statens Planteavls Laboratorium at Lyngby, Denmark.

Proceedings of the IV International Soil Science Conference.

The Proceedings of IV International Soil Science Conference — articles in original languages — edited conjointly by the International Institute of Agriculture and the Italian organizing Committee of the Conference, was published in book form last June and at once put in circulation.

The whole consists of 3 volumes containing 1758 pages, — tables and 183 figures and is a standard reference book on Soil Science. The general secretary — and acting president — of the International Society of Soil Science Dr. D. J. HISSINK has sent the following letter of thanks to the President of the International Institute of Agriculture, S. E. G. DE MICHELIS :—

" C'est mon devoir d'exprimer à votre Institut la reconnaissance de l'Association Internationale de la Science du Sol pour la participation qu'il a eu dans l'achèvement de cette grande œuvre, ce qui est une grande acquisition pour la Pédologie ".

A most careful index forming a valuable aid for its use has also been published.

Price of the three volumes	250	Lires It.
" " " index	30	" "
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Formation of the Italian Section of the International Society of Soil Science 19 July 1926.

At the last session of the Italian organizing Committee of the IV Conference of Soil Science, the President, Prof. G. de ANGELIS D'OSSAT presented the three volumes of the Proceedings of the Conference and expressed his thanks and those of the Committee to all who had collaborated in the interesting work. He drew special attention to the work of Prof. R. PEROTTI, secretary of the organizing Committee and of the Conference. A financial Statement was then made by Prof. PEROTTI and was approved.

On completion of the business and before declaring the meeting at an end the President, DE ANGELIS D'OSSAT, proposed the formation of an Italian Section of the International Society of Soil Science. The proposal was carried unanimously.

A provisional Committee of management was appointed to act until the meeting of a General Assembly. Its members were :—

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The above mentioned members are requested to send their subscriptions for the years 1925 and 1926 as soon as they see this notice.

In countries where there are national sections the subscriptions may be paid to the secretariat of these sections.

Dr. D. J. HISSINK
Acting President and General Secretary.

Erratum. — In the article by A. v. NOSTITZ, vol. II, 1 page 10, illus. 2, it should read " Increase of water-draining power " instead of " water capacity ".

Papers.

THE CONSUMPTION OF ARTIFICIAL FERTILISERS IN AUSTRIA IN 1925.

The use of artificial fertilisers in Austrian agriculture has increased greatly in recent years despite the generally unfavourable condition of the country and the neglect of this problem by the special agricultural government departments. It is due to the endeavours of farmers to repair their losses in the war by the most practicable increase in production. An appreciation of the possibility and of the necessity for agricultural progress is only found where education, that natural condition of growth, credit and market facilities are either good or at least bearable. Such advantages are met with in the Lower Austrian lowlands. According to information kindly supplied to the author by Dr. Rudolf Haas, head of the firm Heilgern and Haas of Vienna, 50-80 % of their total sale of artificial fertilisers goes to that part of the country. True, progress can also be observed in other parts of the country, but it is at present on a smaller scale, owing to the economical and technical difficulties met with in all attempts at intensification.

With regard to the origin of the artificial fertilisers used by Austria, the country produces about 45,000 q. of sulphate of ammonia, *i. e.* more than is used up annually by its agriculture. Since the spring of 1925 Austria has been capable of producing annually up to 500,000 q. of superphosphate, in the very modern works of the Wodawerke-Wetzler Co. Ltd. at Moosbierbaum. But the very uncertain economic and political situation of Central-Europe only permits of a very slow development of the scheme. All other kinds of artificial fertilisers, with the exception of a small quantity of so-called Reform phosphate, have to be imported.

The following tables give an account of the employment of the different kinds of artificial fertilisers in 1925 and the corresponding

consumption in 1924. The data are derived partly from official sources *e. g.* Austrian trade statistics, partly from private sources, especially from my collaborator Dr. HAAS.

1. *Nitrogenous fertilisers.*

	Quitnals 1925	Quintals 1924
Sulphate of Ammonia:		
(*a*) Home production	35 480	32 640
(*b*) Imported	5 247	1 830
Total	40 727	34 470
Nitrate of soda	47 193	37 457
Calcium Cyanamide	55 091	35 315
Ammonium nitrate	5 687	3 710
Leuna nitrate	4 796	—
Total	153 494	110 952

2. *Phosphatic fertilisers.*

Superphosphate:		
(*a*) Home production	44,250	—
(*b*) Imported	325 327	284 409
	369 577	284 409
Thomas slag	324 328	343 123
Bone meal, slag phosphate etc,	80 000	60 000
Total	773 905	687 532

3. *Potassium fertilisers.*

Potassic salts	192 630	142 996

Thus it is seen that the employment of nitrogenous fertilisers increased by 39 %, the synthetic products being of the greatest importance. Of the phosphatic fertilisers superphosphate shows a 30 % increase, Thomas slag a slight decrease. The use of potassium salts shows a rise of 35 %. These figures justify great hope for the further development of the Austrian artificial fertiliser industry.

Bad Ischl. End of July 1926.

Dr. F. W. DAFERT
Wien.

THE CONSUMPTION OF ARTIFICIAL FERTILISERS IN DENMARK

The consumption of artificial fertilisers has increased very greatly of late as the following summary will show:

Annual Import of Artificial Fertilisers into Denmark in Million kg. (1).

Period	Nitrogen fertiliser	Phosphoric acid fertiliser	Potassium fertiliser
1871–1880	0.1	15.0	0.0
1881–1890	0.3	17.3	0.1
1891–1900	3.0	38.0	6.1
1901–1910	9.5	79.4	12.4
1910–1920	41.1	144.0	37.8
1921	105.0	80.2	14.6
1922	103.3	201.9	29.9
1923	123.4	231.9	42.4
1924	142.6	261.1	45.5
1925	174.5	288.1	47.5

The import figures correspond very closely to the actual consumption of the country, for apart from the change from raw phosphates to super-phosphates, there is no production of artificial fertilisers in Denmark worthy of mention, nor is there any export.

During 1924-25 the import of nitrogen, phosphoric acid and potassium fertilisers was divided between the separate fertilisers as follows:

I. *Relative consumption of the separate nitrogen fertilisers (% of total import).*

	1924	1925
Sodium nitrate	37.0 %	32.1 %
Calcium nitrate	50.3 „	44.7 „
Ammonium sulphate	11.3 „	22.5 „
Calcium cyanamide	1.4 „	0.8 „

The consumption of ammonium sulphate, which was small until 1923, has since shown a large relative as well as actual increase, while

(1) Figures taken from the report of the Danish Co-operative Fertiliser Co. 1925.

calcium cyanamide, which has never been used in large quantities in Denmark, has now almost disappeared from the market. Sodium nitrate is almost exclusively used in the form of Chile saltpetre.

II. *Relative consumption of the separate phosphoric acid fertilisers.*

	1924	1925
Raw phosphates	44.5 %	44.0 %
Superphosphates (about 18 % P_2O_5)	46.8 ,,	51.1 ,,
Thomas phosphates	8.4 ,,	4.9 ,,
Bone meal	0.3 ,,	0.0 ,,

Imported raw phosphates are not used directly as fertilisers, but exclusively as raw material in the manufacture of superphosphates. The amount of 18 % superphosphates produced is almost double that of the raw phosphate imported from which it is made. We may say that in 1925 about 95 % of the phosphoric acid fertiliser used for agricultural purposes in Denmark was in the form of superphosphates.

III. *Relative consumption of the separate potassium fertilisers.*

	1924	1925
37 % potassium fertiliser	92.1 %	95.4 %
Kainit and 20 % potassium fertiliser	7.9 ,,	4.6 ,,

The greatest consumption of potassium fertiliser was of the high percentage salt.

As the following table indicates, the relative prices between cereals and artificial fertilisers have varied during recent years in a direction favourable to agriculture.

Relation between prices of cereals and of artificial fertilisers.
(From the report of "Det Landøkonomiske Driftsbureau").

Year	Average price of cereal per 100 kg. in crowns	Price of weight unit artificial fertiliser in relation to price of weight unit cereal		
		Calcium nitrate	18 % superphosphates	37 % potassium fertiliser
1909–14	12.83	155	48	93
1920–21	39.29	117	61	86
1921–22	26.31	131	50	87
1922–23	23.59	133	41	76
1923–24	25.39	134	36	67
February 1925 (1)	37.19	94	26	44

(1) From « Landbrugsraadets Meddelelser », February 6. 1925.

As a result of this development, artificial fertilisers are used on nearly all Danish farms at present. Based on a report of the Danish Co-operative Fertiliser Association, 1924, with statistics from 10,000 farms, we find that this year:

98 % of the Danish farmers used artificial phosphoric acid fertilisers
94 % » » » » » nitrogen fertilisers
64 % » » » » » potassium fertilisers.

The average consumption per ha. was:

Superphosphates	115 kg.
Nitrogen fertilisers	52 »
37 % potassium	16 »

We may say that what characterizes the consumption of artificial fertilisers at present in Denmark is the very large amount of phosphoric acid fertiliser used in proportion to nitrogen and particularly potassium fertiliser.

Statens Planteavls-Laboratorium, Lyngby, Denmark, 10 *August,* 1926.

Harald R. Christensen.

CONSUMPTION OF CHEMICAL FERTILISERS IN EGYPT

For some time economic conditions have forced new practices on Egyptian agriculture, among others intensive manuring of the soil. To procure the fertilising materials which neither the live stock nor the natural resources of the country (*Tafla, Marog* or *Koufri*) any longer suffice to supply, the cultivator has recourse more and more to chemical fertilisers with whose use he was unacquainted 25 years ago.

The importation of these fertilisers did not really start before the year 1900, but in 1910 it already amounted to nearly 3600 tons; in 1914 about 75 000 tons, and in 1925 it has gone up to more than 258 000 tons. Such a rate of progress is, as far as we know, unexampled in the world.

We must recognise that the merit for this development belongs largely to the Royal Agricultural Society of Egypt, the principal importer.

It is this Society which has introduced these fertilisers and given instruction in their proper use, nor has it ever ceased to lavish its advice, based on exact experiment, on cultivators.

A list is here given of the quantities of various fertilisers imported into Egypt from 1902 to 1925.

As may be seen, *nitrogenous fertilisers* formed the greater part of the imports. This is because throughout the alluvial soils of the Nile nitrogen is the element which is most lacking, and the " limiting factor " of the crops. Of all nitrogenous fertilisers that which is most appreciated by cultivators and which is by far the most used is *Chile Nitrate*. In 1925, 173 764 tons of its were imported, representing 68 % of the total chemical fertilisers and more than 88 % of the nitrogenous fertilisers. It was moreover the first chemical fertiliser to be introduced into the country.

The other nitrogenous fertilisers imported consist of *cyanamide, sulphate of ammonia, nitrate of lime* and, for the last two or three years, *nitrate of ammonia, urea* and *Leuna nitrate* or *nitro-sulphate of ammonia*.

These last two are still in the experimental stage. However out

Imports of chemical fertilisers into Egypt 1902-1925
(in metric tons)

Years	Chile nitrate	Nitrate of lime	Sulphate of Ammonia	Cyanamide	Superphos-phate	Other Fertilisers	Total
1902	—	—	—	—	—	—	2 152
1903	—	—	—	—	—	—	3 423
1904	—	—	—	—	—	—	4 791
1905	—	—	—	—	—	—	6 207
1906	—	—	—	—	—	—	12 725
1907	—	—	—	—	—	—	23 119
1908	—	—	—	—	—	—	11 521
1909	18 530	—	354	—	2 255	26	21 165
1910	30 505	—	1 660	—	3 318	76	35 559
1911	48 771	—	1 039	—	9 497	55	59 962
1912	56 047	—	1 650	728	11 459	205	70 089
1913	56 474	—	561	971	13 148	500	71 654
1914	52 325	—	2 633	771	15 278	1 603	72 610
1915	53 076	—	1 048	—	7 056	63	61 243
1916	19 350	—	2 620	201	3 250	11	25 432
1917	32 662	—	1 628	—	2 580	70	36 946
1918	2 888	—	173	—	—	10	3 071
1919	54 468	—	1 289	—	1 435	526	57 718
1920	98 889	—	3 431	430	13 772	3 724	120 246
1921	35 157	3 155	1 764	—	3 571	100	43 747
1922	97 350	7 597	2 758	25	10 378	99	118 207
1923	70 315	3 943	4 660	253	22 516	68	101 755
1924	121 835	7 956	4 955	—	43 146	1 195	179 087
1925	173 764	14 494	9 565	967	55 803	3 713	258 306

N. B. — The "Total" before 1910 was mainly composed of Chile nitrate.

The drop of 1916 to 1919, especially that of 1918, was due to special conditions during the Great European War (V.M.M.)

of the 3713 tons shown in the table of imports for the year 1925 under the heading " other fertilisers " 3000 tons are Leuna nitrate.

Most of the *nitrogenous fertilisers* are used for manuring winter cereals, *especially wheat.*

There is however an increasing tendency to use it for maize, the chief crop of the flood season.

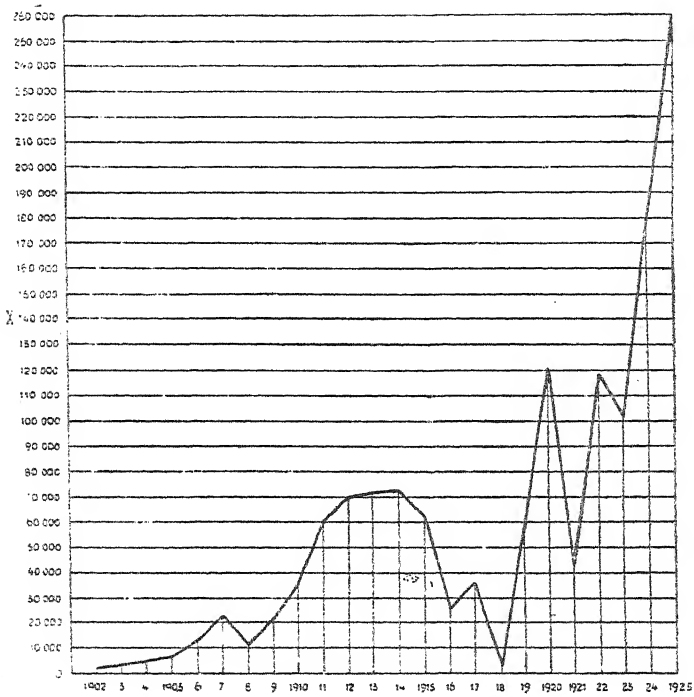

FIG. 121. — Import of Chemical Fertilisers into Egypt in metric tons.

As regards summer crops (sugar-cane, cotton, rice, sorghum, etc.), they only absorb a relatively small portion of it.

The following table, although it only relates to figures of sale of *Chilie nitrate* by the Royal Agricultural Society, figures which only constitute a fraction of the total sales, gives, we think, a fairly exact idea of the *relative consumption* of the various crops, while at the same time it illustrates the increasing use of chemical fertilisers in Egypt :—

Years	Summer crops (1) or *Sefi* crops	Flood crops (2) or *Nili* crops	Winter crops (3) or *Chétoni* crops
	Tons	Tons	Tons
1913–1914	2 272	4 216	20 836
1914–1915	2 406	4 673	27 901
1915–1916	5 249	5 916	13 466
1916–1917	6 762	5 601	18 482
1917–1918	4 687	8 986	16 944
1918–1919	462	28	5 803
1919–1920	3 329	8 224	26 091
1920–1921	9 696	13 575	22 187
1921–1922	2 167	9 434	20 575
1922–1923	3 781	10 190	25 593
1923–1924	11 069	15 213	24 213
1924–1925	11 231	13 993	25 931

(1) = Cotton sugar-cane and sorghum mainly. — (2) = Maize. (3) = Cereals, principally wheat.

Generally from 100 to 200 kg. of nitrate of soda, or the equivalent in other nitrogenous fertilisers, is given per *feddan* (1), according to the crops. The spreading is done, once or twice, either broadcast for winter cereals, or in mass at the foot of each plant, for maize, cotton, sugar-cane, etc. (2).

Formerly the cultivator distributed the farmyard manure at his disposal among the various crops of the rotation, except leguminous crops i. e. on cotton, wheat or barley, flax, maize, sorghum, sugar-cane) Now that the value of the land, and consequently rents, have considerably increased, there is an increasing tendency to reserve the farmyard manure and to give it to the maize in conjunction with nitrate; a little is also given to the cotton, while other crops receive only chemical fertilisers.

The following data are the averages obtained in the course of experiments made by the Royal Agricultural Society.

These figures, however, do not give an exact idea of the advantages of the new practice over the old one.

Compared with ordinary manuring with farmyard manure, that with nitrate of soda, for example, gives with *wheat* an increased yiedl

(1) The *feddan* measures 4200 square metres. It is practically the equivalent of one acre. (V.M.M.)

(2) For further details, see the special notices published by the Royal Agricultural Society (V.M.M.)

Yields in quintals per hectare.

Crop	Nature of the soil	North of the Delta		Centre of the Delta		South of the Delta		Middle Egypt	
		With Nitrate	Without Nitrate	With Nitrate	Without Nitrate	With Nitrate	Without Nitrate	With Nitrate	Without Nitrate
Wheat.	Silicious-argillaceous soil.	18.85	10.50	—	—	26.36	17.90	—	—
	Black argillaceous soil. .	18.40	15.14	17.92	11.28	—	—	107.3	4.71 (v. poor soil)
Barley.	Silicious-argillaceous soil.	24.32	17.91	—	—	—	—	—	—
	Black argillaceous soil. .	25.00	18.40	17.82	11.05	—	—	—	—
Maize.	Silicious-argillaceous soil.	36.33	26.15	—	—	33.19	19.00	—	—
	Black argillaceous soil. .	30.01	17.35	—	—	—	—	—	—
Rice. .	Black argillaceous soil. .	37.47	32.42	—	—	—	—	—	—

of at least 150 kg. of grain and 250 kg. of straw per *feddan*, which at present prices means a net gain of £2 to £3.

The manuring of *maize* with chemical fertilisers, mainly nitrate of soda, practically unknown up to 1911, now absorbs nearly 20,000 tons of this fertiliser.

This crop, perhaps the most important in our list, offers a large market for nitrogenous fertilisers, covering as it does more than *two million* feddans yearly and being the most exacting crop in respect of nitrogenous manuring on account of its very short vegetative cycle and its place in crop rotation (after the summer fallowing during which nitrification is nil).

Up to 1911 the cultivators were in the habit of using most of the fertilising substances produced on the farm, always in insufficient quantities, for the maize, to the great detriment of the succeeding crops. Now they increasingly adopt the practice of giving it a combined manuring of farmyard manure and nitrate; the farmyard manure is buried before the sowings, to the extent of half the accustomed quantity and the latter is applied two or three times before the first or between the first and second irrigations, in quantities of 100 to 150 kg. per *feddan* in *takbich*, that is to say in packets at the foot of each plant. This combination of farmyard manure and nitrate has real advantages as regards yield and the soil itself. Compared with normal manuring with farmyard manure only, this combination produces an excellent average which varies from 300 to 600 kg. of

grain per *feddan* according to soils and the rotation. The financial advantage at present prices would be £2 ½ to £3 per *feddan*.

As regards *séfi crops*, sugar-cane, of which about 60 000 *feddans* are planted annually, is the crop which consumes most nitrogen in the form of *tafla, marog, koufri* or *nitrogenous fertilisers*. It is given up to 200 kg. or more of nitrate of soda or the equivalent in other nitrogenous fertilisers, which is applied usually once or twice as described above.

Cotton absorbs relatively little nitrogenous or phosphatic chemical fertilisers. It is mainly cotton crops of Middle and Upper Egypt which are given about 15 kg of nitrogen in the form of nitrate or other nitrogenous fertilisers (100 kg. of nitrate of soda). Cotton crops of the northern regions of the Delta, on soils *sufficiently freed from salt*, sometimes get the same quantity or half of it, according to the soils. The resulting surplus varies between one half and one *kantar* of lint.

Sorghum, flax and certain *market garden crops* are beginning to be consumers of chemical fertilisers.

As *phosphatic fertilisers*, only *superphosphates*, simple or concentrated, are used, but principally simple superphosphates containing from 16 to 18 % of phosphoric acid soluble in water or in citrate of ammonia.

At the present time from forty to fifty thousand tons of it are used annually.

Phosphatic fertilisers are mainly reserved for *bersim* (Trifolium Alexandrinum), the most important of the leguminous crops of the Egyptian rotation, and for beans ; a certain amount is applied to cotton.

200 kg is usually given per *feddan* (1).

Additional potash not being necessary for the normal soils of Egypt, scarcely any *potassic fertilisers* are imported.

In short, *at present* Egypt imports *mainly nitrogenous fertilisers* which are applied *principally* to *wheat, maize* and *sugar-cane*, all three belonging to the *Gramineae*.

Barley, cotton, sorghum as well as *rice, flax* and a few *market-garden crops* certainly absorb a certain quantity of them, but the practice of manuring these crops with chemical fertilisers is still in its infancy.

(1) For further details, see the special notices published by the Royal Agricultural Society.

Moreover, notwithstanding the progress made, Egypt, which produces an insufficient quantity of farmyard manure, still offers a large market for chemical fertilisers, especially nitrogenous fertilisers, principally for those with immediately and rapidly assimilable nitrogen. A simple calculation suffices to prove this.

As a matter of fact, the area occupied during the 3 agricultural seasons of the year by the different crops of the country amounts on the average to 8 million *feddans*. If we consider only the chief crops which might receive nitrogenous fertilisers with advantage, we get the following figures :—

Maize	1 900 000	feddans
Cotton in Upper Egypt	500 000	»
Sugar-cane	50 000	»
Wheat	1 450 000	»
Barley	350 000	»
Total . . .	4 250 000	feddans

without counting the market-garden crops, rice, sorghum, etc.

Allowing an average manuring per feddan of 100 kg. of nitrate of soda, the quantity susceptible of being absorbed by Egypt works out to some 400 000 tons.

Evidently only a relative value can be assigned to this limited figure. It is none the less true that Egypt is still far from consuming the quantities of fertilisers which its intensive cultivation and its soil relatively poor in nitrogen require.

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THE USE OF FERTILISERS IN SPAIN

Table of Production and Imports of artificial fertilisers during the years 1922-23-24-25.

Fertiliser		1922	1923	1924	1925
		Tons	Tons		
Natural Lime Phosphates	Imported	248,459	350,672	—	—
	Produced in Spain	—	5.397	—	—
Superphosphates	Imported	62,053	96,923	134,000	154,000
	Produced in Spain	—	608 830	750,000	800,000
Slag Imported		9,068	15,283	12,000	10,000
Potassic Salts	Imported	12,746	15,619	6,000	6,000
	Produced in Spain	—	—	—	18,000
Chile Nitrate Imported		46,167	92 602	135,982	120,639
Synthetic Nitrate Imported		6,789	11,328	12,529	12,000
Sulphate of Ammonia	Imported	77,214	84,828	—	—
	Produced in Spain	—	5,607	124,220	139,797

The 1923 totals merit attention, the total fertilisers available in that year being: Natural Phosphates 356 069 tons, Superphosphates 105 753 tons, Slags 15 283 tons, Nitrates of soda 103 929 tons, Sulphate of ammonia 90 434 tons, Potassic salts 15 618 tons.

Notes. — There is a noticeable increase during these years in the use of fertilisers, superphosphates being most employed, imports having fluctuated in the last two years from 17.8 to 11.5 % of the total amount used. The Spanish factories do not produce up to their maximum: in 1925 they may be considered to have only furnished 65.6 of their working capacity.

The amount of natural phosphates produced in 1923 is but small, only 5 397 tons, whereas imported phosphates amount to 350 672 tons. Since the working of the rich Spanish ores does not produce much phosphate, slags must be imported; they are however scarce on the market and cannot be used as much as would benefit the numerous lime-poor Spanish soils.

Fertilisers furnishing nitrogen in a nitric form are imported, as they are not produced in the country, Chile nitrate having in 1923

represented 88 % of the total amount consumed, the remainder showing the marked influence of synthetic nitrates. As to ammonium fertilisers an easing of the present commercial position might enable the formation of a synthetic N company using the Claude process, which would greatly increase the present small national output.

The consumption of potassic fertilisers is equally capable of expansion, since the discovery of layers of potassic salts in Catalonia will doubtless increase their use, especially if cheaper than the imported ones. The same applies to nitrogenous fertilisers, their present high price preventing them from being used as much as they might be, a high proportion of the sulphate of ammonia being absorbed in the Levantine zones, where they are intensely employed for the growing of fruit, vegetables and rice.

Superphosphates may be said to be used to a varying extent for all crops. The buyer of fertilisers has grown more confident since the Royal Decree of November 14, 1919 guaranteeing his rights.

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DEVELOPMENT IN USE OF FERTILISERS IN FRANCE

Cultivated soils generally contain all the mineral elements necessary for the nourishment of plants, but it is seldom that these elements are found in them in sufficient quantities to enable the plant to develop fully.

Moreover it is evident that soils become progressively impoverished in elements taken away in the crops produced.

It was in the middle of last century that, thanks to chemistry, our knowledge in this matter was made precise.

The use of chemical fertilisers, which has now become general, first started then. It consists in incorporating regularly in the soil nitrogenous, potassic and phosphatic products and in bringing in, in the form of lime or carbonate of lime, the calcium which is the fourth necessary element, of which moreover agriculturists have been too neglectful for some years, forgetting that it is useless to spread nitrogenous, phosphatic and potassic manures at great cost on a soil deficient in calcium. Doubtless the reason will be found in the high cost of lime, due to scarcity of coal, and that of marl, due to excessive cost of transport. The decalcification of soils is surprisingly rapid and agriculturists must realize that limings and marlings form the very basis of all rational manurings.

NITROGENOUS FERTILISERS.

The following table gives the annual position of our pre-war provision of nitrogenous fertilisers:

Products	Production in Tons T. = 1000 kg	Imports in T.	Total	Nitrogen content	
				Average	Total in T.
				%	
Nitrate of soda	nil	290 000	290 000	15	42 500
Sulphate of ammonia	75,000	20 000	95 000	20	19 000
Crude ammoniac	7,500	5 500	13 000	8	1 040
Cyanamide	7,500	500	8 000	15	1 200
Nitrate of lime	nil	9 500	9 500	13	1 235
Commercial nitrogenous fertilizers:					
a) Guanos, dessicated meat and blood, leather, horns, fish refuse, etc.	7,000	53 000	60 000	6	3 600
b) Glue residues, wool refuse, oil-cake, sewage, etc.	40,000	—	40.000	3	1 200
				Total	70 775

The figure 40 000 tons for commercial nitrogenous fertilisers (*b*) is only given here as an indication, for want of precise statistical data.

No account was taken of farmyard manure, for like green manures, it is immediately restored on the spot to the very soil from which it is derived. We are considering only the products which bring into the soil, from outside, supplementary elements of fertility.

The above figures may be summed up as follows :—

Nitrogen produced	18 070	Tons
Nitrogen imported	52 705	„
Nitrogen consumed.	70 775	Tons

Nitrate of soda formed nearly two-thirds of the nitrogen consumed.

The law of 29th December 1923 authorized the Government to set up at the Toulouse Powder factory the manufacture of synthetic ammonia, corresponding to the fixation of at least 100 tons of nitrogen per day, or at least 30 000 tons a year.

Referring to the figures in the table above, it is seen that this production alone sufficed to reduce by over one-half our imports of nitrate of soda

It is to be hoped that our consumption of nitrogenous products will rapidly increase. In an important report on the question of nitrogen made on the 22 November 1922 by M. MATIGNON, Professor at the Collège de France, in the name of the Fertilisers Commission of the Ministry of Agriculture, he estimated the normal requirements of agriculture at 140 000 tons of nitrogen, or double the prewar consumption. Consequently we ought to look for an increase and not a decrease in our nitrate imports in spite of the Toulouse factory, if the building of other factories were not luckily envisaged. One other factory is already working at Bethune where George CLAUDE'S process is in use. Other are in process of construction for the same process or by the similar Casale process.

Lastly we can expect a considerable increase in the production of cyanamide, which was unimportant before the war.

It is known that the synthetic manufacture of ammonia requires :—

1) the preparation in a state of great purity of both hydrogen and nitrogen ;

2) the mixture of these two gases, in the proportion of three volumes of the first to one of the second, then the passage of this mixture, previously compressed to 200 atmospheres (Haber process) or to 700 atmospheres (Casale process) or to 900 or 1000 atmospheres (C. Claude process) through a tube raised to a red heat, containing a catalytic metallic mixture (catalyser) which causes them to combine ;

3) the ammonia is produced and collected either in the state of gas (G. Claude and Casale) process) and fixed in the form of sulphate or hydrochlorate or transformed into nitric acid (used for making nitrate of ammonia) or lastly into urea.

The Toulouse factory will profit by all these and will make use of the Haber process in the manufacture of hydrogen and nitrogen but one or other of the two processes is the actual synthesis of the gases. From this brief account, it is evident that competition will soon become very active in the world's market for nitrogenous fertilisers between nitrate of soda, which has hitherto been completely master of the situation, and the new synthetic nitrogenous fertilisers, principally sulphate of ammonia.

But we have not yet reached the point where this rivalry will by competition bring about a decrease in cost favourable to agriculturists. Nitrate still dominates the market and on it are based the rates for all nitrogenous products. Now the purchase of nitrate is done in pounds sterling and the rates of freight are fixed in English money ; that is to say the price of nitrogenous fertilisers depends directly on the course of exchange.

In 1925, the French consumption of the chief nitrogenous fertilisers was :—

Nitrate of soda	280 000 T.
Sulphate of ammonia.	261 000
Cyanamide	58 000
Nitrate of lime	15 000

Deliveries of nitrate of soda keep up to pre-war figures. On the other hand an important increase is registered for the consumption

of sulphate of ammonia, which has gone up from 80 000 Tons in 1920 to :—

125 000	Tons in	1921
133 000	»	1922
153 000	»	1923
202 000	»	1924
261 000	»	1925

The supply of sulphate of ammonia was assured in 1925 by :—

117 000	T. of French production
8 000	imported from England
145 000	imported from Germany on reparations account.

PHOSPHATIC FERTILISERS.

Superphosphates. — Phosphate of lime, of which there are important beds in Tunisia, Algeria and Morocco, should be made practical use of, transformed into superphosphate by treatment with sulphuric acid (100 kgs. of phosphate giving in this way 180 kgs. of superphosphate). Before the war, the French consumption of superphosphate reached 1 800 000 Tons, requiring 1 000 000 tons of phosphates.

In 1925, the quantity of phosphates imported reached 1,534,000 T. of which :—

1 012 000	Tons	came	from	Tunisia
377 000	»	»	»	Algeria
145 000	»	»	»	Morocco.

The development of the Morocco beds should be noted. They have exported 1921 8000 T., 1922, 80 000 T., 1923 190 000 T., 1924 430 000 T., 1925 721 000 T.

At present the superphosphate factories are largely supplied and are able not only to satisfy all agricultural demands, but even to export annually over 200 000 T. to foreign countries.

Ground phosphates. — The transformation of phosphates into superphosphates is costly and for a long time agriculturists have sought means of utilizing the natural phosphate directly. Experiments have recently been made in the stations of the Institute of Agricultural Research on phosphates ground to a condition of extreme fineness by various processes. But the results are not encouraging. Assimilibility does not increase with the degree of fineness as might

a priori be supposed, and moreover mechanical pulverization becomes extremely expensive when it is desired to get a certain degree of fineness. We may then conclude that normally the use of ground phosphates only gives good results in granite soils, such as those of the "Plateau Central" and of Brittany, in cleared land, and also in wet peaty grass lands; moreover rather large doses must be used.

Usually superphosphates and dephosphoration slags are essential.

The pre-war consumption was about 100 000 T. a year. Reduced to 25 000 T. during hostilities, it has now returned to the pre-war figure. The beds of phosphated chalk of the Somme and the Yonne are ample for our needs.

Dephosphoration slags. — The manufacture of steel from phosphatic iron ores gives a slag in which all the mineral phosphate is found in the state of phosphoric acid readily assimilable by plants.

Before the war, about 400 000 T. of this fertiliser were used annually in France out of a production of 617 000 T.

French power of production has considerably increased since the war, owing to the restoration of the Steelworks of Lorraine and also to the occupation of the Sarre basin.

Our production of slags is thus more than double the pre-war figure: Germany on the other hand formerly a large exporter now finds her production insufficient for her own wants. French consumption had gone up in 1925 to 550 000 T.

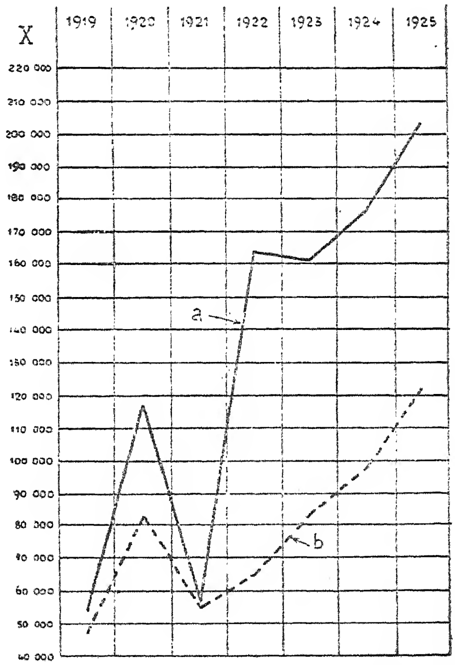

FIG. 122. — Production of Potassic Salts by Alsace mines: a = used in France, b = exported.
X = amount in metric Tons.

POTASSIC FERTILISERS.

Before the war our consumption was estimated at 37 000 T. of pure potash a year, derived from seaweed

ashes, distillery ashes (*sugar beet*) and the mother-water of salt marshes, and partly imported from Germany.

Our actual requirements are much greater and all agriculturists deplore the parsimony with which potash salts were used by our farmers. The situation has greatly improved since the restoration of the Alsace mines, the production of which has also gone up considerably from 591 000 T. of salts containing 98 000 T. of K_2O in 1919 to 1,926 000 T. of salts containing 310 000 T. of K_2O in 1925. Sales in France have made similarly interesting progress, the consumption having gone up since the armistice from :—

1919	47 000 T. of pure potash
1920	85 000 » » » »
1921	55 000 » » » »
1922	63 500 » » » »
1923	81 000 » » » »
1924	98 000 » » » »
1925	122 300 » » » »

SUMMARY.

French production and consumption have progressed very considerably on previous years.

The Administration, notably through its services of agricultural instruction, tries to inculcate a larger use of fertilisers.

Manufacturers, makers and importers particularly interested have decided to rearrange their propaganda with a view to obtaining better results.

Some years ago a propaganda syndicate was formed for developing the use of fertilisers in France, and this has already published a large number of tables, leaflets and notes conceived in a purely objective spirit, where all idea of commercial advertisement in favour of such and such a firm is rigorously prescribed. This propaganda, which cannot be too much encouraged, appears to give excellent results.

In conclusion, we may recall the interesting commercial events of the year.

REPRESSION OF FRAUDS IN THE MATTER OF FERTILISERS.

The passing of the law of 19 March 1925 which, by modifying Article 4 of the law of 4 February 1888, does away with the possibility of the vendor delivering his products with the stipulation of regulation of price according to the results of analysis.

This law strengthens the provisions of the law of 4 February 1888 relating to he obligation of the vendor of fertilisers to furnish the purchaser with all useful information regarding the nature, the origin of the said fertiliser, the content and origin of the fertilising elements which it contains, and the method of their combination. It makes it compulsory for the vendor to give to every purchaser a detailed invoice and requires him to affix to the packages a label giving the exact content in fertilising elements.

DEPHOSPHORATION SLAGS. — Prohibition of export restored for the months of September and October with the object of reserving for French agriculture a normal supply which large exports threatened to compromise.

POTASH. — Agreement concluded between the mines of Alsace and the Kali-Syndicat aiming at the suppression of competition between the two countries, increased production and trade outlets and fixing the share of sales in the world's markets.

NITROGEN. — Progressive development of the installation of synthetic nitrogen factories in various places and state of progress of works in course of execution at Toulouse.

PRICE OF FERTILISERS. — General increase in prices, more considerable for nitrogenous fertilisers, which, quoted in the world's markets in English currency, suffer directly from the effect of the depreciation of the franc. For phosphatic fertilisers, a less considerable rise, due to increased cost of production. For potassic fertilisers, a slight increase thanks to the policy of large output practised by the mines.

In 1925, the prices of the principal fertilisers varied as follows :—

Price per 100 kgs.	1st January 1925	31st December 1925
Superphosphates 14 %	20 to 22 F. per 100 kgs.	26 to 27 F. per 100 kgs
Bone » 16 %	36	43
Thomas Slag 18 %	15.65	18
Nitrate of soda	107	155
Sulphate of Ammonia	110	132
Cyanamide	82.50	93.75
Sylvinite 12 %	0.45 per unit	0.50 per unit
» 20 %	0.55 » »	0.60
Chloride of Potash	0.90 » »	1.00
Sulphate of Potash	1.50 » »	1.60

E. ROUX,

THE QUESTION OF FERTILISERS IN THE SOVIET UNION

The use of mineral fertilisers has hitherto been little developed in Russia. The cause of this is not the natural fertility of the soil — statistics show that the average yield per hectare is only half of the average yield in France and one-third of that in Germany, nor is it the ignorance of the peasants which prevents the use of fertilisers, but the cause is purely economic: the prices which the Russian peasant gets for his wheat are, as a general rule, much smaller than those ruling in Western Europe. It is impossible to wait until the level of prices in the interior of Russia may at an expected moment reach that of Western Europe, so persistent is the necessity of exporting wheat. This means that it is impossible to expect in the immediate future the same development in the use of chemical fertilisers in Russia observed in wheat importing countries. Cases as in exceptional years, such as 1925, of prices rising to an extraordinary height and falling again quickly after a short time, cannot sensibly alter the consumption of chemical fertilisers even during these exceptional periods.

Even if it were possible to forecast changes in prices one year in advance, during the preparation of the soil for winter wheat for example, it would nevertheless be impossible to give the chemical industry dimensions which would correspond to the conditions of an exceptional year.

We must therefore adopt a different scale for measuring our development of chemical fertilisers than would apply to countries of intensive agriculture, a scale suitable to their economic conditions.

As an example of this difference in conditions, it suffices to state that the price of wheat in Russia is ordinarily one-third of the price of nitrate. Obviously this precludes the use of nitrogenous fertilisers for cereals : it is only industrial crops, such as sugar-beet which repay the use of nitrate and that in very small quantities.

The use of potassic fertilisers is still more restricted. There are no beds of well determined potassic salts, but there are indications which render the existence of such beds probable. By a boring made recently near Solikansk (Ural) the presence of sylvinite was noted at a depth of 92 metres, but the question of extent can only be solved by further borings.

Conditions for the use of phosphatic fertilisers are relatively more favourable, and there are several beds of phosphates (though of very variable value) ; the soils need phosphate almost everywhere in the European part of the Union, except the steppe soils in the South-East. Certain difficulties arise in the question of phosphates owing to the geographical distribution of the raw material necessary for the manufacture of superphosphate. The beds of pyrites, for example, are found in the Ural, while superphosphate is most necessary for Western Ukraine, where the growth of sugar-beet is greatly developed. The pyrites has therefore to be transported two thousand kilometres or more.

Beds of phosphates are very common, but they are not always of such quality as to enable them to be used for the manufacture of superphosphate. According to M. SAMOÏLOV's estimate, the total quantity of phosphates contained in the beds in European Russia amounts to 5570 million tons. As regards richness in P_2O_5 an uneven distribution is observed between the following groups :—

Phosphates containing	Millions of tons	%
I. 24 % P_2O_5 and above	141.7	2.5
II, 18-24 % P_2O_5	1 708.3	30.6
III. 12-18 % P_2O_5	3 720.0	66.9
	5 570.0	100.0 %

In Southern Russia only in Podolia are there beds rich in P_2O_5, but quantitatively these beds are insufficient to assure the development of the chemical industry adequate to the wants of the Ukraine. The most abundant deposits are found in North-East Russia in the Ural between the Rivers Kama and Viatka, where not only the cultivation of beetroot but also the population is lacking in a land without railways or navigable rivers. In spite of all this, the manufacture of superphosphate is now being developed in the interior of the country, whereas before the war, superphosphates imported from abroad or made at Riga with imported phosphates or pyrites, were almost exclusively used. The following figures show the increase of production in recent years :—

	1923-24	1924-25	1925-26
Production of superphosphate	28936	57196	102600 tons (1)

(1) In the official sources the final figures relate to the period from the 1st October of each year up to the 1st October of the following year, for this reason the figures for the year 1925-26 are here given approximately.

These figures merely summarize the production of various factories.

Name of the factories	1923-24	1924-25	1925-26 (*)
	tons	tons	tons
Cernorecensk (near Nishny)	11 577	20 304	40 000
Kinechma	2 340	3 193	—
Perme	2 262	1 995	14 000
Vinniza (Podolia)	7 952	21 632	30 000
Ekaterinoslav	3 515	4 275	8 000
Odessa	1 290	5 376	10 000
Samara	—	420	—

(*) The figures in the last column are approximate. Figures are only given for superphosphates, because Thomas-slag is not now produced in Russia.

As has already been mentioned, the first object of the industry at its present state of development is to satisfy the requirements of the Ukraine in superphosphate for the growth of sugar-beet. The second task incumbent on it is the supply of Turkestan, for its cotton cultivation. With this object the scheme was for a factory of double superphosphate at Samara, but so far this has not materialised.

As a final but more remote goal a sufficiently large production of superphosphate might be obtained to reduce its price, so as to allow the general use of this fertiliser for ordinary crops, such as cereals and clover. The work of numerous agricultural stations records in most cases an energetic action of phosphatic fertilisers on the yield of cereals, especially in the black soil region which contains sufficient nitrogen. For example, the Agricultural station of Kharkov, after ten years of experiment, has obtained the following averages :—

	without manure	with supers.	with F. Y. M.
Rye Crop	12.6	23.8	25.8 q. m.

Favourable results have been obtained in many regions, but the causes indicated above prevent the use of superphosphate as fertiliser for cereals : hence the use of phosphatic fertilisers cheaper than superphosphates becomes interesting. Under certain conditions (1) especially in the region of acid soils (podsols), it was long ago observed that ground mineral phosphate could replace superphosphate.

(1) See details in the author's book :— Düngerlehre, 1923. Paul Parey, Berlin (translation of the 5th Russian edition).

This practice, for example, existed under the Smolensk Government for 40 years (initiative of Prof. ENGELGARDT) : lately it has been ascertained that the black soil near its northern boundaries, where it has undergone a certain disintegration, is capable of reacting to phosphates not treated with sulphuric acid. These results have been noted in the Toula and Orel governmental regions.

Considering that for this object phosphates of inferior quality could be used, a start was made in exploiting the neighbouring beds at Kourek and Briansk, so as to decrease the cost of transport and deliver the phosphates at the lowest possible prices.

Methods were also sought to enable poor phosphates, so common in Russia, to be used for the manufacture of concentrated phosphates, containing phosphoric acid in assimilable combinations. The known methods leading to the production of double superphosphate and precipitates being too costly, the process of reduction and distillation of phosphorus under conditions corresponding with those of blast furnaces (M. BRITZLKE's method) for example, were studied. The preliminary researches and calculations have given very favourable results and experiments of manufacture on an industrial scale are now being tried. Differences in the natural and economic conditions and in the properties of phosphates and other raw materials render thorough research necessary, adapted to local needs of agriculture in the different parts of the Union. The work of research is divided among the 20 Agricultural stations and Colleges in the Union. In addition, there is at Moscow a Central Institute for fertiliser research, which includes three divisions (geological, technological and agricultural) and has at its disposal corresponding laboratories, plant houses and experimental fields.

The Institute's aim is to combine the work of various specialists for investigating the sources of raw material, finding suitable methods of manufacturing fertilisers and of their use under the actual conditions which determine the character of the country's agriculture.

The fertiliser Institute publishes its works in Russian with summaries in French, English and German.

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Abstracts and Literature.

General.

Determination of soil manurial requirements by the Neubauer method.

DENSCH. Erfahrungen mit Methode Neubauer. *Zeit. f. Pflanzenernährung und Düngung*, Vol. V, Part. B. Wirtschaftlich-Praktischer Teil, No. 2-3, pp. 97-104, February-March, 1926.

LEMMERMANN, O. Die Bestimmung des Düngungbedürfnisses der Böden durch Laboratoriumversuche. *Ibidem*, pp. 105-117 and pp. 133-143.

BLANCK, E. Beiträge zur Bestimmung des Düngerbedürfnisses des Bodens. *Ibidem*, pp. 118-125.

NEUBAUER, H. Die Bestimmung des Düngungbedürfnisses des Bodens durch Laboratoriumversuche. *Ibidem*, pp. 126-128.

In the papers quoted the writers refer to their experiments and the conclusions which they were able to draw from them on the NEUBAUER method, a method which NEUBAUER considers to be the only one giving an idea of the quantity of nutritive substances contained in the soil and soluble through the roots, and which, in contrast to the empiric methods hitherto adopted, should give a basis for the scientific investigation of the soil.

The investigators mentioned are of different opinions. DENSCH considers that there are many difficulties in the way of the introduction of the NEUBAUER method and that in its application the influence of light and perhaps also of temperature should be confirmed, while the application of laboratory results in open fields is always of questionable value, inasmuch as the figures obtained show disagreement between them not only as regards P_2O_5, but also for K_2O.

LEMMERMANN found that the same sample of soil, examined at different times, gave entirely different values of P_2O_5 soluble for the roots and it is a matter for further investigation whether such differences are due to the various influences of light, temperature or other local influences, or whether the sample of soil may suffer changes during the time it is kept. In any case the method is here at fault and it must be more thoroughly investigated and improved before being used for practical purposes.

According to BLANCK, the NEUBAUER method does not gives as satisfactory results as the method of relative solubility of the phosphoric acid of the soil in 0.5 % solution of citric acid. The differences which are established between NEUBAUER's method and growth experiments with oats indicate that it is an insufficient test, especially for borderline soils.

A test between the two methods, NEUBAUER's and the citrate method, has been made by LEMMERMANN. With the former, soils containing up to 6 mg. of P_2O_5 are indicated as needing manuring, between 6 and 8 as doubtful, above 8 mg. as not needing manuring. With the citrate method the limiting values were respectively 20 mg.; between 20 and 25;

over 25. Results which were obtained with the same soils were however different.

LEMMERMANN then refutes NEUBAUER's assertion that this method differs from the others, which are purely chemical, in being founded on a physiological basis. According to LEMMERMANN no such contrast exists; NEUBAUER's method takes little account of the laws of plant physiology while the so-called chemical methods are not exclusively so, but take into account in the preparation of the solutions the solvent power of the roots, and their use has been proved on the basis of practical research. This does not prevent NEUBAUER's method also, in the hands of an accurate worker who thoroughly knows all its difficulties and weaknesses, from being found useful, at least when it has been completed from a technical point of view. A. F.

The determination of soil manurial requirements.

GERLACH. Die Bestimmung des Düngerbedürfnisses des Boden. *Landwirtschaftliche Jahrbücher*, Vol. LXIII, No. 3, pp. 339-368. Berlin, 1926.

With the exception of peat soils most soils possess insufficient quantities of active nitrogenous substances and therefore need heavy manuring. The question is to find the proper amount of artificial fertilisers, of stable and green manure to add to the soil. Leguminous plants do not require nitrogenous fertilisers.

As far as most German soils are concerned, it is observed that they contain considerable quantities of potassic and phosphatic combinations which by themselves, or in conjunction with stable manure only, are sufficient to meet requirements for many years. Poor potash content is to be feared for peaty and light sandy soils; potatoes, barley, meadows and pastures all need potash.

Some information regarding the phosphatic requirement of the soil may be obtained by the citrate method and NEUBAUER's method, but not the exact quantities necessary. Light sandy soils require phosphates which can be given to them by the addition of heavy soils in which phosphoric acid may be in a state of combination with iron or in the clay particles. Potatoes, meadows and pastures require phosphates.

The need of lime is connected with soil reaction and the new methods for its determination give sufficient indications regarding the necessity or inutility of giving lime.

The reaction of the superficial part of the soil is influenced by the artificial fertiliser used; with a rational alternation of the latter, manuring with lime may be rendered superfluous.

The requirements of soils as regards other substances, such as silica and silicon chloride are still unknown.

On the whole however it must be said that we cannot previously determine the precise quantities of artificial fertilisers which are necessary in a year for a given soil, all the more so because such quantities depend largely on the rainfall which cannot be previously determined.

Our insufficient knowledge should not however lead to starving our plants and it is better to give too much than too little.

The old rule of first manuring abundantly with cheap potassic and phosphatic fertilisers and of then giving nitrogenous fertilisers during the period of growth still holds good.

The administration of sufficient quantities of fertilisers raises the total cost of production, but gives a larger and better crop and thus decreases the relative cost of production. A. F.

On the physiological reaction of fertilising salts.

KAPPEN, H. and LUKACS, M. Zur physiologischen Reaktion der Düngensalze. *Zeit f. Pflanzenernährung und Düngung*, Vol. V, No. 4, p. 249-270. Leipzig, 1925.

In the theory of the physiological reaction of fertilising salts, there are always some controversial questions ; above all the manner of the acid and basic physiological actions of these salts remains unexplained.

The writers' experiments are in fact aimed at clearing up several of the points at issue. They have first of all observed that maize can grow well in solutions of nitrate of ammonium, in spite of strong acidification, probably because of the amphoteric nature of this salt. Their researches also tend to show that potassic salts act as physiologically acid, the acidity however being not much less than that of chloride and sulphate of ammonium. Relating to this theory is the question of the state in which nutritive salts become absorbed by plants, whether that is to say undecomposed or in the form of ions. The latter hypothesis appears most probable, so that decomposition into ions would take place outside the plant itself. It cannot yet be stated whether the penetration into the cell of the molecules of the acids and bases takes place by absorption or by diffusion. A. F.

Fertiliser Investigations at Rothamsted.

Rothamsted Experimental Station, Report for 1923-1924, pp. 130, Harpenden, 1925.

Attention is drawn to the enormous loss from wastage of nitrogen contained in farmyard manure and artificial fertilisers, the value of which in Great Britain represents a sum not less than £8 000 000 or £9 000 000 per annum.

The results obtained from some of the fertiliser investigations were as follows :—

Sulphate of Ammonia : The average gains per acre from the use of 1 cwt. of sulphate of ammonia were :

	1922 Rothamsted	1923 Rothamsted	1924 Rothamsted Outside centres	Average of all soil and seasons to 1920	
Wheat (bushels)	3.25	—	—	4.3–6	4.5
Barley (")	5.5	4.5	8.16	3.5	6.5
Oats (")	—	8.3	—	—	7.0
Potatoes (cwt)	20	22–25	20	—	20
Swedes (")	20	25	5–9	30	20 N. Country 10 S. Country

The effect of doubling the nitrogenous dressing is to give a further crop increase ; in the case of cereals the increase is not infrequently more than double that obtained from the single dressing, as shown by the following data :

	No nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Increment in yield for	
				1st cwt.	2nd cwt.
1923 Oats (bushels)	29.2	37.3	46.5	8.1	9.2
Straw (cwt)	19	26	36	7	10
1924 Barley (bushels)	23.9	32.5	42.7	8.6	10.2

In the case of potatoes the second increment is usually less than the first, although the higher dressing is still profitable.

The time of application of the dressing is important for cereals, the later dressings being more effective than earlier applications, but for potatoes the application of sulphate of ammonia with the seed has been more effective than when given later as a top dressing to the young plants.

Barley : The results of three years investigations into the effect of manures on the yield and quality of barley, differ somewhat from the current teachings of agricultural science. It is usually recommended that the manuring for barley should be mainly phosphatic, nitrogen being given only after a corn crop and potash but rarely. Out of 30 tests this would have caused loss of money in no less than 26. The average reduction in yield in bushels per acre, consequent on the omission of each fertiliser during 1922, 1923 and 1924 has been :—

Decrease due to omission of :	After a straw crop	After roots fed off	After potatoes or beets (well manured)	Mean of all experiments
1 cwt. sulphate of ammonia	5.8	3.9	6.7	5.4
3 cwt. superphosphate.	0.9	(0.5)	1.2	0.5
1½ cwt. sulphate of potash	(1.1)	1.3	1.1	0.3

(the figures in brackets are increases, not decreases).

The reasons for these results are probably : (1) Modern varieties of high quality barley are stiffer in straw and can carry larger crops of grain without risk of lodging. (2) Farmers give good dressings of superphosphate to root crops and sufficient of this fertiliser generally remains in the soil for the barley.

So far as the investigation has gone it suggests that farmers using a good modern variety of barley can aim at the highest crop that will stand,

and can use the appropriate fertilisers to secure this, without fear of loss in value.

A remarkable effect is obtained when the chloride of ammonia is substituted for the sulphate. In every instance the value of the grain has been raised and its nitrogen content lowered.

Basic slags and grass land: Examination shows that slags fall into two main groups: those in the making of which fluor spar is used: and those to which no fluor spar is added. The fluor spar slags are often less effective. Further, some slags were found to contain substances harmful to plants, or that to some extent counteracted the effect of the phosphate present.

Potatoes: Investigations carried out with various potash salts showed that the percentage of starch in the dry matter of all tubers analysed was higher with sulphate of potash than with any of the other salts.

Green Manuring: Experiments with mustard ploughed in on October 18, 1923, followed by winter oats, harvested in August 1924, were as follows :—

Basal manure	Yield of Oats After mustard ploughed in	(bus. per acre) after fallow (no mustard)	Increase due to Mustard	
			Bushels	Per cent
None.	43.3	25.0	18.3	73
5 tons town refuse	51.8	27.1	24.7	91
10 " " "	49.3	30.6	18.7	61
Average	48.1	27.6	20.5	74

Leguminous Crops: Pot experiments showed that unrotted straw greatly increases the number of nodules formed on each clover plant, but there was no increase of yield until phosphates were added.

It was also found that many leguminous plants fail to grow unless supplied with traces of boron. W. S. G.

Necessity of manuring in the State of São Paulo (Brazil).

COELHO DE SOUZA, William W., A fertilidade natural de nossas terras. *Ceres*, Vol. II, No. 1, pp. 174-176. São Paulo, 1926.

Generally prejudice prevents the use of fertilisers in the tropics, but this is not always so, seeing that the chemical composition of the soil varies tremendously just as in European and temperate countries of other continents.

In the State of São Paulo not all the soils are rich in nitrates, on which account artificial nitrates are required, especially where for centuries the same crop has been grown or products for export trade to the other States in Brazil.

Chemical analyses of various soils of the State of São Paulo have often indicated the almost total absence or scarcity of nitrates necessary for profitable agricultural production.

The habit of burning the forests to obtain land free from trees for cultivation transforms the mineral substances of the surface of the soil, which the heavy rain then washes away, leaving the soil sandy and deprived of the substances required by the crop.

It is known that after some years not a little of the unmanured land of the State of São Paulo can no longer produce rice, maize, cotton, or sugar-cane. E. M.

The influence of artificial fertilisers on the structure of the soil.

RENNER, W. (Agrikulturchemisches u. bakt. Institut der Univers. Breslau). Der Einfluss verschiedener Düngesalze zumal von Kalk und Phosphaten auf die Struktur des Bodens. *Zeit f. Pflanzenernährung und Düngung*, Vol. IV, No. 10, p. 417-451, 16 tab. Leipzig, 1925.

Oxide of calcium, added to soils, usually has a decidedly favourable effect, in the way of helping flocculation. Carbonate of lime acts similarly but to a lesser extent.

Thomas slag and Rhineland phosphates cause considerable alterations in the physical properties of soils only when given in large quantities. The action of sulphate of calcium is slight and, in some cases, rather unfavourable. Superphosphates act similarly, and in no case cause flocculation. A. F.

Pasture Top-Dressing in New Zealand.

WARD, F. E. and HUDSON, A. W. *New Zealand Journal of Agriculture*, Vol. XXX, No. 6, pp. 393-402, Tables 5. Wellington, 1925.

In many parts of New Zealand top-dressing of pastures has been carried out for many years, but under the conditions of Canterbury, with light rainfall and short-rotation pastures, top-dressing has not generally been practised.

Experiments were carried out in 1923 and 1924, the manures being selected to test soluble phosphates (super) against the less soluble phosphates (basic super), and to note the effect of dried blood used in conjunction with these phosphates.

From data obtained the following conclusions were drawn:—

In all cases except that of basic super and dried blood, the cost of manures was more than paid for by the increase in one crop of hay. The use of dried blood for top-dressing of pastures cannot be recommended.

The crop increases due to the second application of manure were not so great as those due to the first dressing.

The manures increase the palatability of pastures.

The increased development of clovers was considerable.

W. S. G.

The action of alkaline chlorides on plants and soil.

DUPONT, C. (Station agronomique de Nancy). Action exercée par les chlorures alkalins sur les plantes et sur les sols. *Ann. de la science agronomique française et étrangère*, Vol. 41, No. 6, pp. 369-391. Paris, 1924.

The use of chlorides as fertilisers tends to increase and agriculture uses sylvinites largely because they have the advantage of containing very

available potash at low cost, while chloride of ammonia places nitrogen at the disposal of cultivators under good conditions.

This use of chlorides as fertilisers, which is expected to increase, has been objected to, and certain consequences of the application of sylvinite and attributed to the action of chlorine have caused a certain distrust. For this reason the writer has thought it well to make experiments to see whether any toxic action can really be attributed to the chlorine.

The yield of wheat did not decrease with a dose of kg. 3350 per hectare, and the same held good for flax, with which however such a quantity, given in the form of chloride of sodium, exercised a slightly toxic action absent when given in the form of chloride of calcium.

The yield of mustard increased with kg. 1300 per hectare, decreased with double that quantity: lupins stood the former quantity well, disappeared with the double dose. Very sensitive were vetches and buckwheat, which were destroyed respectively by doses of 1700 and 870 kgs. per hectare.

On germinating seed chlorine has a decidly toxic action, to which wheat is more resistant. The addition of chlorine increases the quantity of this element contained in the plants, in an unequal manner varying with the various plants, without there being any absolute relationship between the quantity of chlorine absorbed and the toxic action exercised. In alkaline soils alkaline chlorides diminish the alkalinity of the soluble potash, but when the soil is poor in potash and the alkalinity of the soluble potash is therefore reduced, the contrary effect is produced. The diminution of the alkalinity of the soluble potash, under the influence of the chlorides is only apparent and is due to the precipitation of lime from the chloride of calcium existing in the plant by the carbonate of potassium formed during calcination. In the soil, the transformation of chloride of potassium into chloride of calcium depends absolutely on the soil's absorption power. Such transformation is almost integral in clay soils and is on the other hand scanty in sandy soils, poor in colloidal elements. Chloride of sodium undergoes such transformation in a lesser degree because the soil's power of absorbing is less.

Calcium salts have little effect on the absorption of potash, while they have considerable retarding action on that of sodium; hence they cause the formation of chloride of calcium to decrease at the expense of that of sodium.

If, as in the case of sylvinites, chloride of potassium and of sodium are introduced into the soil, the chloride of calcium, formed at the expense of that of potassium, prevents the transformation of chloride of sodium and lessens the decalcification which might occur by reason of this salt.

For the useful employment of sylvinite the following dangers should be avoided :—

1) The toxicity of the chlorides (application must be a long time before seeding).

2) The losses in drainage water, results of incomplete absorption of potash by the soil (surface application in spring).

3) Enrichment in sodium of the argillaceous colloids of the soil

and the resulting decalcification and bad physical condition of the soil. Such drawbacks are not to be feared in soils containing a sufficient quantity of lime and in a good state of chemical activity, while they may be found in soils lacking carbonate of lime, badly manured or when using excessive quantities of poor sylvinite. A. F.

The influence of a complete mineral fertiliser on the growth of wheat.

CHAUSSIN, J. Etude du milieu intérieur et des tissus insolubles ou cours du développement du blé. Influence d'un engrais minéral complet. *Ann. de la Science agronomique franç. et étrangère*, Year 42, No. 2, pp. 124-144, 5 fig. Paris, 1925.

Manured wheat, with more rapid growth and higher yield, has higher osmotic pressure in the leaf and stem and a larger proportion of mineral matter in the soluble portion of the leaf than unmanured wheat.

The leaf, which is the principal laboratory of the plant, except during its primary growth and important migrations at the end, shows a remarkable constancy in the composition of its internal sap. The large proportion of mineral matter which is found in the soluble part of the leaf and which may be as much as 20-30 and even 40 %, is a fact which should claim attention from the point of view of the function of these mineral substances in the hitherto obscure mechanism of assimilation.

It appears that the Gramineae have a lesser faculty than other species (leguminosae) of abstracting the necessary mineral substances from the soil. A. F.

The growth of various part of plants under the action of different stimulants.

JACOBI, H. (Biolog. Versuchsanstalt der Akad. der Wissenschaft in Wien). Beeinflussung des Wachstums morphologisch ungleichwertiger Pflanzenteile durch verschiedene Reize. *Oesterr. Botanische Zeit.*, Vol. LXXV, No. 1-3, p. 29-42, 4 fig., bibl. Vienna and Leipizg, 1926.

It is known that the winter rest of woody plants may be shortened by the action of known stimulants. Also certain parts of the plant which do not remain attached to it, but which contain reserve materials, may be brought to a certain stage of development by the action of such stimulants; this happens, for example with pollen and seeds.

The writer's researches have in fact shown that some salts in determined concentrations (solutions of chlorides of potassium, calcium, sodium and magnesium) are able to cause resting parts of the plant to develop. Concentrations of a slightly weaker strength than N/1000 are active for the development of the pollen of *Impatiens Sultani* in the absence of sugar; greater dilution (for example, 1/10,000) has no effect.

Chloride of magnesium does not cause any activity, that of manganese retards development. Pollen tubes growing in solutions of chloride or nitrate of potassium also show a strong protoplasmic current.

With the same solutions it is possible to cause the development of buds and leaves of *Siringa vulgaris* and to accelerate the germination of seeds of *Phaseolus vulgaris*. With *Siringa vulgaris* and *Impatiens Sultani* the most noticeable action is caused by potassium salts.

Buds of *Siringa vulgaris*, which during the resting phase, in darkness, do not germinate, may be caused to develop by being punctured or injected with distilled water or solutions of potassium salts. A. F.

The Influence of Aluminium, Manganese and Iron Salts on the Growth of Sugar Cane, and their Relation to the Infertility of Acid Soils.

McGeorge, W. T. *Experiment Station of the Hawaiian Sugar Planter's Association*, Bulletin, No. 49, pp. 95. Tables 18, figs. 33, bibliography. Honolulu, 1925.

The author gives details of an investigation as to the cause of the low fertility of acid Hawaiian soils, the tonic action of certain acid salts, particularly those of aluminium, being especially studied.

The conclusions reached were as follows :—

(1) Salts of aluminium in concentrations which are present in many acid Hawaiian soils have a retarding action or even a severe toxic action on the growth of sugar cane.

(2) Manganese salts have no effect on the root growth of sugar cane in water cultures.

(3) Acidity *per se* or hydrogen ion concentration of the intensity present in most of the soils examined has no influence on the growth of cane. It is the aluminium salts present in such soils that retard growth.

(4) Aluminium toxicity is a direct toxic action, and not a phosphate deficiency, although increasing the phosphate or potash reserve increases the plant's resistance.

(5) Cane plants grown on acid soils containing soluble iron and aluminium have abnormal accumulations of those elements in the nuclei surrounding the xylem cells at the nodal joint of the stalk.

(6) Acid soils containing aluminium respond markedly to soluble phosphates, also to heavy applications of potash.

(7) Lime gave little or no immediate response.

The investigations show that aluminium is a factor directly associated with the retarded growth of sugar cane on acid lands; also, that both potash and phosphate may exert an influence other than as a direct plant food. W. S. G.

Influence of Fertilisers in Protecting Corn against Freezing.

Magistad, D. C. and Truoge. *Jnl. of American Society of Agronomy*, Vol. 17, No. 9, pp. 517-526, Bibliography. Geneva, N. Y., 1925.

It is well known that the greater the concentration of dissolved materials in a liquid, the lower is the temperature at which the liquid freezes. Hence, if the application of fertilizers increases the concentration of dis-

solved materials in the plant sap, then such application should lower the temperature at which the plant freezes.

The authors' investigations showed that application of fertilizers in proximity to the plant increases the osmotic pressure of the sap of young maize plants, and lowers the freezing temperature of the plant from one to two degrees Centigrade, which is often sufficient to prevent maize being frozen by late spring frosts. Owing to this action there is an additional reason for the use of fertilizers in northern latitudes, for certain crops which are grown on soils subject to late spring frosts. The greatest benefit in this way, from the use of fertilizers, will occur on peat soils, poor sands and other soils of low soluble salt content. W. S. G.

Manual of Agrarian Chemistry.

PROTOLUNGO, U. One Vol. in 24 (mm. 100 × 150) of 524 p., 16 fig., 20 diagrams, U. Hoepli ed. Milan, 1925.

The contents of this manual are fundamentally limited to pedology and the doctrine of the fertilisation of the soil. Real and proper plant chemistry is therefore not dealt with in it. Considering, however, that pedology and still more the doctrine of soil fertilization are closely related to plant physiology, the first five chapters are on physiological plant chemistry. He then proceeds to investigate the soil from a lithological, physical and chemical point of view, alluding now and again to microbiology and enlarging specially on the relationship between the qualities of the soil and the vegetation. The second part is devoted to the fertilisation of the soil and he considers improvement devices and correctives, nitrogenous, phosphatic, potassic and mixed fertilisers, their production and use.

In separate chapters Italian soils are described and statistical data on Italian production and consumption of fertilisers are referred to.

A. F.

Soil Improvement methods.

The rate of solution and action of calcareous fertilizers.

MANSHARD, E. Orientierende Untersuchungen zur Frage der Lösung-bezw. Wirkunggeschwindigkeit verschiedener Düngekalkformen. *Zeit. für Pflanzenernährung und Düngung*, Vol. VII, No. 1, p. 31-53, 5 fig., 2 tab., Leipzig, 1926.

The experiments were made with :—

1) Calcareous lyes, containing 8.51 % of chlorine and 25.99 % of Lime, of which 13.68 % in the state of CaO ; 2) marl ; 3) cretaceous limestones.

It appears on the whole that none of the products used, even in strong doses of 100 q. per ha., have given noteworthy effects. Although the lime was dug in to a depth of 6-8 cm., the reaction of the zone at 10-20 cm. remained acid, and even strongly acid. Even the calcareous lyes did not show any superiority from this point of view over the marls and limestones, moreover the presence of chlorides in them acted in an unfavourable manner.

The cretaceous limestone, notwithstanding its coarser degree of pulverization, has a more rapid neutralizing effect than marl. It also seems that the structure of the various calcareous products is of considerable importance. A. F.

The transformation of quick-lime in the soil.

SCHEFFER, F. (Institute of Agricultural Chemistry of Göttingen). Ueber die Art der Umwandlung des Aetzkalkos im Boden und ihre Ursachen. *Journal für Landwirtschaft*, Vol. 27, No. 4, p. 201-235. Berlin 1924.

In soils poor in carbonate of lime and also in those with a neutral reaction, the transformation of CaO into $CaCO_3$ does not appreciably take place, inasmuch as a large part of the CaO becomes otherwise combined. Such a change on the other hand noticeably takes place in soils rich in $CaCO_3$. In the others the quantitative course of the transformation becomes retarded by substances which act as absorbents. As such may be mentioned gelatinous silicic acid and the mixture of gelatinous $SiO_2 + Al_2O_3$. Gelatinous SiO_2 has also the power of decomposing $CaCO_3$. A. F.

Organic Manures.

Farm-yard manure fermentation.

WEIGERT, J. (Landesanstalt f. Pflanzenbau und Pflanzenchutz; München). Mitteilung über den derzeitigen Stand und die bisherigen Erfahrungen bei der Gärdüngerbereitung. *Zeit. f. Pflanzenernährung und Düngung, Wirtschaftlich-Praktischer Teil*, Vol. V, No. 4, p. 144-161. Leipzig, 1926.

LEMMERMANN O. (Landw. Hochschule u. Landw. Versuchstation f. Brandeburg u. Berlin). Das Verfahren der sogenannten Heissvergärung des Stalldüngers. *Ibidem*, p. 162-168.

This patented process by which is obtained the so called "*Edelmist*" (noble dung) is carried out as follows :— The manure is placed in small square based heaps 60 to 90 cm. high and never pressed down. The internal humidity ordinarily reaches 75 %. The heaps are covered with old tarred roofing felt and the mass is allowed to ferment. When the temperature has reached 60°-75°, which is generally found to be the case in a couple of days, the heap is strongly pressed down on the ground and another heap is placed on top of it, when it is then left for at least 4 months. The aim of compression is to arrest bacterial life, though obviously this is not achieved, since this goes on evenly and, as happens in the ordinary heaps of manure, only diminishes gradually.

Among the advantages attributed to the method is the killing of the denitrifying germs. This is not confirmed by LEMMERMANN's researches, not would it be of importance in any case, since such germs are found in all cultivable soils.

It is asserted that this "noble dung" contains nitrogenous combina-

tions more easily utilizable by the plant. From the comparative researches carried out it appears that its action is about 30 % of that of sulphate of ammonium, which corresponds with the action of common stable manure.

It would be useful to know the quantity of organic matter and nitrogen lost with this process in comparison with the common method ; it appears that the losses are greater using the special method. As regards chemical analyses, it should be observed that there are such differences in the various analyses of this product as to prevent any conclusion being drawn from them.

Practical tests of manuring have been slightly in its favour ; it should however be taken into consideration that the common manure used for comparison was not of very good quality and consequently it is necessary to repeat the experiments on a large scale.

The subject matter of its advertisements is also based on the possibility of its giving the soil a carbonic manuring, the very possibility of which is of too controversial a nature to allow it to be of any value.

In conclusion, this method is worth serious consideration, but needs further research before a definite opinion on its merits can be reached.

A. F.

The value of stable manure in Brazil.

FERREIRA DE CARVALHO, J. Adubo de curral. *O Agricultor*, Year IV, No. 6, p. 10. Lavras Minas (Brazil), 1925.

Hitherto no " fazendeiro " has considered stable manure as important, and consequently it was not used as fertiliser, while the cultivated land became impoverished and the crops decreased. As the Brazilian farms (" fazendas ") are almost always mixed, that is to say also rear animals, it is very easy to restore to the soil 80 % of the substances derived from it, which then return to the cultivated plants.

Stable manure compared with other fertilisers proves better in most cases.

A cow of 300 kg. produces on the average 8540 kgs. of solid excrement which contain :— 42 kgs. of nitrogen, 21 of phosphoric acid and 42 of potash, elements which have inclusively a value of 269 paper " milreis " (equal to 358 sh. at par values). Considering the high prices of chemical fertilisers in Brazil this is no negligible value. A farm which has fifty cows will so produce a large and valuable amount of manure, which owing to faulty or non-existent storage has hitherto been lost.

An easy method of keeping stable manure consists in making a trench of size suitable to the amount of dung produced and with a cement bottom to prevent loss of the liquid portion by infiltration into the soil.

The first layer put into the trench is dung, on top of it a thin layer of peat ; on top of the peat is placed another layer of dung and then a layer of straw, and the trench is suitably covered to prevent entry of rain water. Once the trench is filled with stable manure, this is left to season, after which it is taken out and mixed up. For each " alqueire " (one " alqueire " = 11.96 acres) 40 to 50 tons of stable manure are required every 5 or 6 years.

M. E.

The utilization of Algae and marine plants.

DESCHIENS, M. Les utilisations des algues et des plantes marines, *Chimie & Industrie*, vol. 15, No. 55, pp. 675-698. Paris, 1926.

In Europe especially in France, England, Ireland and Norway the variety of seaweeds which are met with is almost always the same; the commonest species are Laminaria *saccharina, Cloustomi* and *flexicaulis,* the Fucaceae and *Choudrus Crispus* or Carageen Lichen. In the United States, the coasts of the Pacific Ocean (California) are particularly rich in huge Laminarias which often attain a size of hundreds of metres. In Japan grow algae specially suitable for food. Among marine plants other than algae should be mentioned the Zostera. From the earliest times the coastal populations have gathered the algae and marine plants of the coast for manuring their land. These roughly dried, broken in pieces and heaped together, begin to ferment and are then capable of being used as fertilisers. Zostera may be used as litter for animals.

The Laminarias are most in request for the manufacture of iodine. Industrially it is estimated that, to obtain 10 kg. of iodine by incineration, it is necessary to treat one ton of seaweed ash. This ton of ash corresponds to 5 tons of sundried seaweed and to 25 tons of fresh seaweed. In 1911 the world's production of iodine was 750 t. of which 175 went to Europe, 75 to Japan, and 500 to Chile for the nitrate industry. Among the numerous industrial and agricultural uses of Laminaria the most important is as a source of iodine and of potassic fertilisers; in addition we have the Algin industry and alginates and derived products, the pharmaceutic uses and their use in the textile industry (printing and stiffening), the use of carageen lichen, the agricultural use of various seaweeds as fertilisers and lastly the utilization of Zostera (" varec ") as substitute for straw in the furniture industry.

During the last few years a great volume of scientific and industrial research regarding the diffierent products of seaweeds has been developed, and especially the extraction of iodine has been widely studied. The more common method of burning the seaweed to extract potash and iodine was rather rudimentary, being based on primitive methods which caused a considerable loss of useful products. Various attempts to avoid this waste have been made by many investigators who undertook the treatment scientifically by means of carbonization in closed vessels, obtaining as by-products combustible gas, tar and coke.

In the process of incineration and carbonization the organic matter is completely lost, which constitutes a grave defect from an industrial point of view. An attempt has therefore been made to extract the iodine and to utilize afterwards the organic matter either as food or in the state of algin.

The industrial processes aim in the first place at effecting a methodical lixiviation of the dry seaweeds with pure water or water slightly acidulated to free these seaweeds from the large quantities of salts. The demineralized organic product is, afterwards, either dried and cut in pieces for use as food for animals, or placed to steep in a solution of

carbonate of soda for the extraction of algin, a mucilaginous substance used for the manufacture of alginates and derivatives.

Many other experiments have been made. In the United States fermentations tests were made to obtain acetic products.

However, in order that the various processes should become industrial and assure an economic profit they must be the object of further scientific research and study especially from a chemical point of view.

Green Manuring for Sugar Cane.

DODDS, H. H. (Director, Experiment Station, Natal). *Planter and Sugar Manufacturer*, Vol. LXXV, No. 14, pp. 269-272. New Orleans, 1925.

Attention was drawn by the author to the exhaustion of the soil organic matter after continuous growing of sugar-cane, particularly where the practice of burning the trash has been followed.

The yield of cane in Louisiana has steadily fallen from 18 tons per acre to 7 tons, the chief cause being the decrease of soil fertility. To meet the deficiency a crop of cowpeas (*Vigna* sp.) was ploughed in before planting cane ; the cane was grown for two years in succession.

If the nitrogen balance be studied it will be found that about 136 lb. of nitrogen per acre are required for the two crops of sugar cane, and the cowpea crop cannot supply more than 78 lb., hence there is still a loss of 58 lb., to which must be added 34 lbs. for the nitrogen in the following crop of maize.

In Louisiana, the cane is planted in October, and it was found that the nitrogen deficiency could be met, without altering the rotation, by sowing *Melilotus indica* on the cane during the same month. The green crop was ploughed in before cultivation of the cane in the spring, and added about 100 lb. of nitrogen per acre to the soil, equivalent to 700 lb. of sodium nitrate.

The average yield of cane increased from 10 to 14 tons per acre, or an increase in value of £ 5 for an outlay of 14*s*. Further, soil exhaustion was checked. The author gives brief notes on plants which may be grown for green manuring, such as : Velvet beans (*Stizolobium*), Mauritius bean (*Saterrimum*), Cowpea (*Vigna* sp.), mung bean (*Phaseolus aureus*), Sunn hemp (*Crotolaria juncea*), yellow sweet clover (*Melilotus indica*), lupins, buckwheat (*Fagopyrum* sp.). W. S. G.

Green Manuring in India.

JOACHIM, A. W. R. *Tropical Agriculturist*, Vol. LXV, No. 6, pp.325-331, Bibliography. Peradeniya, Ceylon, 1925.

The author reviews the scientific investigations on green manuring which have been carried out in India, and studies the factors contributing to the beneficial results accruing to the soil and subsequent crops.

The two chief factors are the nitrogen and the physical factors. The former includes : — Fixation by azotobacter or similar organisms stimulated by the carbohydrates of the green manure ; denitrification induced

by fermentation of the green manure ; possible development of a bacterial toxin.

The physical factor includes : Improvement of moisture-holding power of the soil ; improved retention of plant nutrients ; possibly improved aeration ; change in soil aeration with possibly increased solubility of phosphates.

Experiments carried out on wheat in the Punjab from 1918 to 1922 showed that :—

(1) The response to green manures was much greater in sandy soils than in stiff soils.

(2) Increase in yield in sandy soils was greater in the green manured plots than in plots receiving artificial manure equivalent to the green manure.

(3) The main factor responsible for the increase in yield was the improvement in texture of the soils, due to the green manure.

(4) When the above-ground portion of a leguminous crop was removed, the yield was very much diminished.

(5) Non-leguminous crops were as effective as leguminous crop dressings.

W. S. G.

Utilization of dead bodies as fertiliser on Brazilian farms.

Utilisação dos cadaveres de animaes come adubo nas fazendas. *Revista da Sociedade Rural Brasileira*, Year, V, No. 63, p. 343-344. São Paulo, 1925.

Instead of burying skinned carcases which fertilise only one spot it is advantageous to cut them into pieces and put them in a trench covering them with quick-lime and acid black soil of the fields in alternate layers. After 60 days more lime and earth are added, and so after a certain time a homogenous mixture is obtained which serves as fertiliser in variable amounts from 150 to 300 kgs. per hectare.

Another process consists in dissolving the whole carcase in a cold state in sulphuric acid at 60° Beaumé, an operation which requires 48 hours for soft parts and 8 to 10 days for hard parts.

The bones reduced to powder may be used as phosphatic fertiliser in quantities of 800 to 1200 kgs. per hectare, the effect of which lasts for 3 to 6 years.

E. M.

Nitrogenous Fertilisers.

Nitrification in some organic fertilisers.

Aladjem, E. Note sur la Nitrification de l'Azote dans quelques Engrais Organiques. *Bull. de l'Union des Agriculteurs d'Egypte*, Year 23, No. 161, p. 128-133. Cairo, 1925.

Practically all the assimilable nitrogen in dried blood, guano and pulverized horn nitrifies as rapidly as that in sulphate of ammonium ; on the other hand the nitrogen in hoof parings nitrifies less rapidly than it does

in the above, these but more rapidly than in "poudrette", cocoanut cake, and bone meal in which nitrification is rather slow.

These results indicate that these latter fertilisers should not be used except for crops which require nitrogen during a long period of growth; applied to cereals they would only have appreciable effect if given in great abundance. A. F.

The nitrogen problem.

HESPEL, M. Le problème de l'azote. *Annales de Gembloux*, Vol. 31, No. 11-12 p. 249-257 and 273-286. Brussels, 1925.

The writer investigates the nitrogen problem which is specially interesting to Belgium and recognizes that it occurs for all agricultural crops, but that rational cultivation tends to decrease the need for nitrogenous fertilisers.

Among the various processes of fixing atmospheric nitrogen, the writer recognizes that the Claude and the Haber processes and those derived from them are the most suitable; the country possessing such factories could be free from the burden of imports, by furnishing the raw materials for explosives and agriculture. The combination of the synthesis of nitrogenous products with coke furnaces would improve the conditions of the latter, also enabling coke to be supplied at more reasonable prices. The Government therefore might well interest itself in the matter, and a campaign ought to be launched against the spreading of biased reports purporting to show some superiority or other of Chile nitrate over artificial nitrogenous fertilisers. A. F.

Nitrogen Losses in Cow Urine.

DORSEY, H. *Jnl. of American Society of Agronomy*, Vol. XVII, No. 8, pp. 489-492, tables 6, Genova, N. Y., 1925.

In 1919 BEAR and ROYSTON reported that 92 % of the nitrogen in urine was lost in eight weeks if the urine was kept in flasks in a warm building, but that there was almost no loss of nitrogen in the same period when the u ine was covered with a layer of kerosene.

The author's experiments were made to ascertain the nitrogen losses of urine stored in larger volume and in a cooler place, approximating to usual storage conditions.

The experiment was started on March 29 and continued until October 13, analyses being made at regular intervals.

Very little loss took place before July 1, and in no case reached 50 % by October. By the third month three-fourths of the nitrogen was converted into ammonia, and by October all nitrogen except 5 to 8 % was in the form of ammonia.

The kerosene layer reduced the loss of nitrogen fully 40 % during the whole period, and was far more effective for the first six months. The addition of a small amount of acid phosphate seemed to increase the loss of nitrogen. W. S. G.

The action of urea on soil reaction.

BRIOUX, CH. (Stat. agronomique de la Seine-inférieure). Action de l'urea comme engrais azoté sur la reaction du sol. *Ann. de la Science agronomique*, Year 42, No. 2, p. 115-124, 1 tab. Paris, 1925.

Urea at first acts on the soil as an alkali in consequence of its rapid transformation into carbonate of ammonia ; however, as it gradually nitrifies, the action of the urea becomes decidedly acidifying, approximating to that of sulphate of ammonium.

These remarks explain the facts observed by the writer : oats and white mustard manured with urea had a slower initial growth than in pots manured with nitrate and also without addition of nitrogen.

It is possible that in the sandy soil used by the writer, in which neutralization was effected with ground lime, the transformation of the urea into carbonate of ammonium may have given the soil too strong an alkaline reaction, capable of retarding the growth of the plants. This reaction decreased with nitrification whereupon the plants mentioned grew vigorously

These observations would point to the value in practice of introducing urea and fertilisers with an urea basis sufficiently early.

A. F.

The toxic effect of nitrogenous fertilisers on wheat.

MAUME, L. and DULAC, J. (Ecole nat. d'Agricul. de Montpellier). Sur la période de toxicité de divers engrais azotés à l'égard du blé au débout de sa végétation. *Ann. de la Science agronomique franç. et étrangère*. Year 42, No. 2, p. 81-107, 13 tab. Paris 1925.

The toxic effect of various mineral salts on seeds germinated in water was already known and a scale of the limits of toxicity of the various salts had also been established. The writers have investigated the question, not in aqueous cultures, but in three different types of soils (inert soil, normal arable soil and humiferous soil), observing only the effect on wheat at the start of its growth. They have also compared results of the application of the fertiliser before and 15 days after sowing.

On the whole, fertilisers may be divided into two principal groups :— those which are immediately favourable to the plant and those which on the other hand are only so after certain chemical reactions. Each of these groups corresponds with a particular case of agricultural practice and it is therefore impossible to say *a priori* whether one is better than the other but it is necessary to know the manner in which each behaves under various actual conditions.

Of all the fertilisers, the least toxic are carbonate and bicarbonate of ammonia ; their effect is best with a small dose (30 kg.) but in any case ephemeral ; after the ready nitrification so obtained, only carbon dioxide remains in the soil, of which soils normally contain enough. Also it should be remembered that the bicarbonate cannot develop its action except in a soil sufficiently provided with lime.

Urea is particularly suitable for calcareous soils which nitrify well; it is entirely soluble in water and not toxic, even in strong doses. Powdered horn has rivalled urea in fertilising power, but probably because very finely powdered.

Chloride of ammonium, in order to give a maximum yield, required the elimination of the chloride of calcium which forms its residue; to this fact should be attributed its slight inferiority to sulphate of ammonium.

Galalite should be considered as a slow acting fertiliser, rather useful for southern soils; should be spread a fortnight before sowing.

Taking the height of the stalk of wheat grown as control at 100, we get the following graduations:—

	After 3 days	After 13 days
Carbonate of ammonium	133	136
Urea	133	131
Bicarbonate of ammonium	120	131
Horn	120	131
Nitrate of sodium	77	131
Sulphate of ammonium	131	131
Chloride of ammonium	49	115
Nitrate of ammonium	35	105
Galalite	35	111

Evidently these results cannot be directly applied in practice. They show however that for the reciprocal adaptation of the plant, the soil and the fertiliser, without doubt an important factor to be considered is the period of toxicity of some fertilisers for the young plant during its initial growth. Such a factor is defined by the nature and concentration of the fertiliser, by the nature of the soil, by the interval between the sowing and manuring and, probably, also by the plant species. A. F.

Nitrate Studies on a Manured and Unmanured Soil under Continuous Wheat.

MURPHY, H. F., *Jnl. of Amer. Soc. of Agronomy*, Vol. XVII, No. 11, pp. 734-741. Geneva, N. Y., 1925.

The author describes experiments carried out on an acre of virgin land, ploughed and planted with wheat in 1893, since when it has grown wheat continuously. In 1898 one-half of the land received an application of farmyard manure, which has been repeated, the amount averaging 4 tons per acre over 26 years. The other one-half acre has not received any manure.

The investigations show that:—

Nitrates were produced in much larger quantities in the manured soil. Under greenhouse conditions the manured soil produced 1.68 times more nitrates than the unmanured soil for a period of two months. Under open field conditions 2.24 times as much nitrates were produced.

Spring growth started later on the unmanured plot.

The manured soil was superior under all conditions studied, namely, nitrates present, nitrification and moisture retention. W. S. G.

The Rate of Absorption of Nitrate of Soda by Oats and Cotton when applied at Different Stages of Growth.

APPLETON, W. H. and HELMS, H. B. *Jnl. of Amer. Soc. of Agronomy*, Vol. XVII, No. 10, pp. 596-605. Geneva, N. Y., 1925.

Experiments were made to study the rate of absorption of nitrate nitrogen by oats and cotton, when applied as nitrate of soda, at different stages of plant growth.

The results may be summarized as follows:

(1) When sodium nitrate at the rate of 400 lb. per acre was applied to oats 14 days after planting, absorption of the nitrate was very slow for three weeks. After the third week absorption increased and all nitrate was absorbed by the end of the seventh week.

(2) When the nitrate of soda was applied to oats at later stages of growth, the rate of absorption was more rapid. Nitrate applied 42, 70 and 92 days after planting was completly absorbed in 20, 14 and 10 days respectively.

(3) With both oats and cotton there was a close correlation between the rate of growth and the rate of nitrate absorption.

(4) Sodium nitrate at the rate of 600 lb. per acre was applied to cotton 14, 40 and 61 days after planting. Absorption of the nitrate was complete in 36, 14 and 11 days respectively.

(5) The results of both experiments indicate that the loss of soluble nitrogenous fertiliser by leaching may be reduced by delaying the application until the crop will absorb it rapidly. W. S. G.

Chemical and Biological researches on Cyanamide.

JACOB K. D., ALLISON F. E. and BRAHAM J. M. (Fixed Nitrogen Research Laborat. U. S. Depart. of Agriculture). Chemical and Biological Studies with Cyanamide and some of its Transformation Products. *Journ. of Agricultural Research*, Vol. XXVIII, No. I, p. 37-69, 12 fig., 15 tabl., bibl. Washington D. C., 1924.

Cyanamide becomes rapidly converted into its decomposition products (chiefly urea and ammonia), so much so that it no longer exists 5-10 days after application. Urea also rapidly undergoes disintegration into ammonia and is not accumulated. Other decomposition products (probably dicyanodiamide and guanylurea), capable of precipitation with nitrate of silver, exist for a certain time after the application of the cyanamide.

Nitrification of cyanamide takes place more slowly than that of urea or sulphate of ammonia, especially when the application is abundant. After the first slow period of 2-3 weeks, nitrification proceeds at a normal pace. Only it must be remembered that some of the decomposition products of cyanamide are toxic for nitrifying bacteria and may indirectly cause an accumulation of ammonia.

Cyanamide hydrated or oiled nitrifies as well as untreated cyanamide; the slight difference found for oiled cyanamide is due to the presence of dicyanodiamide in the hydrated cyanamide.

On the other hand the addition of carbonate of calcium retards nitrification. The latter is greatest when the moisture content is about 10 % i. e. ¼ of the saturation amount, while it almost ceases at 40 %. Sterilization of the soil with phenol arrests all nitrification.

Dicyanodiamide added to the soil disappears slowly and only one half of it is decomposed within two months ; the nitrogen which is accumulated in the form of ammonia becomes nitrified rather slowly. In any case the application of dicyanodiamide causes considerable delay in the formation of nitrates from organic substances and also hinders that from sulphate of ammonium, while it has no effect on the ammonification of urea.

Sulphate of guanylurea is decomposed rather slowly in ammonia, which is not accumulated but becomes nitrified ; in the presence of urea, it does not affect ammonification.

Salts of guanidine depress nitrification for some weeks., after which the formation of nitrates is rapid and abundant. Nitrate of biguanidine acts as an inert substance. A. F.

Is the growth of bacteria of leguminous plants possible on other plants ?

KORDES, H. (Inst. f. Agrikulturchemie u. Bakt. der Landwirtschaft, Hochschule, Berlin). Kritische Besprechung der Frage " Impfung der Nichtleguminosen ". *Zeit. f. Pflanzenernährung und Dungung*, vol. IV, No. 9, p. 382-394. Leipzig, 1925.

The question is whether only the leguminosae can absorb free atmospheric nitrogen. Such a supposition is not borne out by facts; the alder tree has morphologically and physiologically quite similar nodules, and by them can fix nitrogen, though the micro-organisms which form them are not however bacteria but actinomycetes. Other plants such as *Melampyrum pratense, Rhinanthus major*, certain Labiates, *Elaeagnus* and one of the Taxaceae, *Podocarpus*, possess similar nodules also having the property of atmospheric nitrogen fixation.

But this property, though not exclusively belonging to leguminous plants, is limited to a few plants only and is definitely not shared by those which are most important for human food, such as cereals.

Another problem which presents itself is that of the adaptability of *Bacterium radicicola* to other plants. It is seen that in cultures it can adapt itself well to decoctions of *Sinapis* and also to those of *Medicago*, but attempts to transplant it then on to the roots of the mustard plant were unsuccessful. The two symbiotic partners, leguminous plants and *B. radicicola*, are therefore adapted to each other ; infection of roots of other plants by this bacillus does not occur in nature and, even in experimental conditions, is quite exceptional.

It might be thought that other micro-organisms possess the property of fixing atmospheric nitrogen. In fact, HILTNER found on the roots of leguminous plants other micro-organisms similar to *B. radicicola* and was able to show in other non-leguminous plants the existence of organisms which have a determined influence on nutrition. From his theory on the rhizosphere and from some results obtained with cereals and beet he did

not, however, feel quite justified in generalizing and still less in considering that this made nitrogenous manuring unnecessary. Quite definitely results cannot be obtained with these bacilli such as we get with the nodules of leguminous plants. By their use however ENGELMANN among others has obtained with rye a crop comparing very favourably with the control plot. CARON with bacilli isolated from the roots of barley has observed the fixation of atmospheric nitrogen.

Too much should not however be expected from these observations, which remain unconfirmed despite the wide publicity given them and the products launched on the market purporting to be bacterial cultures which fix atmospheric nitrogen on the roots of cereals. The efforts of soil bacteriology should be directed towards improving conditions of life for the micro-organisms of the soil, in order that the latter, in turn, may influence the cultivated plants beneficially. This may be obtained by the introduction into the soil of sources of carbon easily assimilable and by the various cultural operations which improve its physical condition.

A. F.

Phosphatic Fertilisers

On the use of phosphorites.

D'IPPOLITO, G. (R. Staz. Agraria di Modena). *Le Stazioni Sperimentali Agrarie Italiane*, vol. 58, No. 7-9, pp. 243-248. Modena, 1926.

The writer here gives new experimental tests of manuring with phosphorites, from which it appears that in every case phosphorite has shown itself as active as superphosphate, having constantly given a slight increase of production even when not associated with sulphur; certainly in the presence of sulphur the advantage is greater.

Hitherto phosphorites have been considered of slight manuring efficiency owing to the insolubility of their tricalcic phosphate; but, according to the new view, the soluble phosphate contained in the superphosphates through physico-chemical reactions in the soil changes slowly to insoluble and then, by consecutive actions, especially of the radical juices, becomes soluble again. In phosphorites solubility is reached in the same way.

For this reason the use of phosphorites is advisable, since their phosphorus, independently of its more or less ready assimibility, represents always a considerable reserve from which successive crops benefit; they are cheaper and may mean a saving of half the ordinary expenditure.

E. G.

The solubility of natural phosphates.

CALCAGNI, O. Contributo allo studio della solubilizzazione dei fosfati naturali. *Le Stazioni sperimentali agrarie italiane*, Vol. LVIII, pamph. 1-6, p. 146-160. Modena, 1925.

From the author's experiments it appears that pure tricalcic phosphate becomes completely dissolved by bisulphate of sodium, while phosphorites

become dissolved differently according to their degree of purity; no loss occurs during the process of solution.

The author has also investigated the action of other solvents, selecting particularly those substances which are used as fertilisers. He has thus seen that bisulphate of potassium behaves in a perfectly analagous manner to bisulphate of sodium as does also bisulphate of ammonium, the last also having the advantage of preventing retrogradation and of favouring the decomposition of tricalcic phosphate in the soil.

The above mentioned bisulphates and nitric acid therefore constitute very good solvents of phosphorites and can partly or entirely take the place of sulphuric acid.

They eliminate, or at least reduce, the drawbacks of the present method of solution and furnish fertilisers of greater value, inasmuch as they themselves, except the sodium salt, are fundamental plant elements. In this way potassium and ammonium are given in the form of phosphates rather than in the usual form, which may possible be an advantage.

A. F.

On the so-called " colloidal phosphorite ".

BOTTINI, E. (R. Staz. Agraria di Modena). *Le Stazioni Sperimentali Italiane*, Vol. 58, No. 7-9, p. 209-216. Modena, 1926.

A phosphatic fertiliser in a very fine, almost impalpable, coffee coloured powder, obtained by a process at present unknown, has recently been placed on the market under the name of " colloidal phosphorite ". It is essentially composed of phosphates of aluminium and iron mixed with organic substances.

On the whole the author's investigations only find the so called " colloidal phosphorite " colloidal to a small extent (9.79 %). Treated with distilled water, with saturated solutions of CO_2, or with solutions of organic or mineral salts it only yields these solvents usually a trace of P_2O_5.

It behaves abnormally in the presence of a 40 % solution of nitrate of ammonia, which dissolves 1.87 % of P_2O_5. Only acid solutions dissolve " colloidal phosphorite " in appreciable quantities and to a greater extent the more concentrated they are. The action of citroformic acid appears similar to that of 4.5 % solution of citric acid.

On the whole, therefore, " colloidal phosphorite " in equal doses, does not show any higher fertilising value than ordinary powdered natural phosphates.

E. G.

Colloidal silica and the efficiency of phosphates.

GILE, P. L. and SMITH, J. G. (U. S. Depart. of Agriculture). Colloidal Silica and the Efficiency of Phosphates. *Journal of Agricultural Research*, vol. XXXI, No. 3, p. 247-260, 4 pl., 1 tab., bibl. Washington D. C., 1925.

In the practice of manuring it is known in a very vague manner that there are reactions between the soil and phosphatic fertilisers which influence the efficiency of the latter.

Thus phosphorites and bone meal can give the same effects as superphosphates in one soil and, on the other hand, be ineffective in another, even with the same crop. The variations in the yield produced by a given quantity of phosphorites in different soils are too considerable to be attributable to the so-called secondary effects, such as the decrease of acidity, the provision of lime, etc. On the other hand the scanty efficiency of phosphorites in quartz sand cultures, and on the contrary the good results which are obtained in certain soils, indicate rather that we must be dealing with conditions which favour the assimilability of phosphates.

The writers have made experiments by growing millet in sand and have observed that the addition of colloidal silica considerably increases the growth of plants manured with phosphorites, while the increase is very slight for crops manured with superphosphates. The increase is approximately proportional to the quantity of P_2O_5 added, but does not seem to have any relationship to the quantity of silica. The addition of a mixed colloid, containing iron, alumina and silica in a pot manured with phosphorites tended to a decreased yield in comparison with that without phosphates. The beneficial action of the silica has been attributed to increased assimilability of phosphates through the increase of the P_2O_5 in solution

Probably the colloidal solution of silica increases the decomposition of the phosphorites, absorbing the hydroxide of calcium which is one of the final decomposition products: it is also possible that the colloid acts by absorbing the OH ions. Analogously the mixed colloid of iron, allumina and silica acts unfavourably by diminishing the quantity of P_2O_5 in solution, because of the soluble iron and aluminium produced by the exchange of bases.

Certainly the action of the silica colloid in the simple medium of the experimental conditions does not correspond with that of the colloidal matter existing in the soil. In any case the increased growth of plants cannot possibly be attributed to increased assimilation of silica. A. F.

Basic Slags and Rock Phosphates.

VANSTONE, Dr. E. *Jnl. of Soc. of Chem. Ind.*, Vol. 44, No. 14, pp. 155-157, figs. 2. London, 1925.

In a former paper (1) the ratio of phosphate soluble in 2 % citric acid to total phosphate content was investigated. It was shown that for three basic slags, differing in phosphate content, the ratio was constant and independent of the weight taken in the test.

As the method of successive extractions with citric acid was employed, it was desired to investigate the ratio of citric-soluble phosphate to total phosphate in the residual phosphate, after a first extraction with 2 % citric acid.

The same slags used for the first experiments were utilised, and it was evident that the residual phosphate is much less soluble than the phosphate removed in the first extraction. These slags are therefore mixtures of phosphates of different solubility in citric acid.

The effect of ignition on the solubility of rock phosphates was also stu-

(1) See *R.* 1925, No. 559, (*Ed.*).

died, and it was found that the solubility was very much reduced by ignition. It was also found that calcium pyrophosphate ($Ca_7P_2O_7$) has a much lower solubility than other calcium phosphates, except fluor-apatite, which is practically insoluble. W. S. G.

Effects of phosphatic manuring on the quality of hay and fodders.

ROBERTSON, G. S. Efecto de los fosfatos brutos y de la escorias de defosfaración en la calidad del heno y de los pastos. *Boletín de la Comp. Admistradora del Guano*, Vol. I, No. 7, pp. 245-250. 1 fig. Lima, 1925.

The most important direct effect of the application of basic slag is the notable improvement in the quality and food value of the fodders. From the writer's experiments it appears that various basic phosphates (mineral phosphates, highly and slightly soluble slags, basic superphosphates) produce the same improvement and in equal measure.

In soils poor in lime, superphosphate has an unsatisfactory influence especially on leguminous plants, inasmuch as it favours grasses.

Mixing it with lime, we get basic superphosphate, which is a stimulant for the leguminous plants.

Lime alone in these soils, does not exercise any action. A. F.

The solubility of phosphates and the growth of Azotobacter.

NIKLAS, H. SCHARRER, K. and STROBEL, A. (Agrikulturchen Inst. der Hochschule Weihenstephan). Phosphatlösiichkeit und Azotobacterwachstum. *Landwirtschaftliche Jahrbücher*, vol. LXIII, No. 3, pp. 387-410. Berlin, 1926.

As regards pure salts, the best growth of azotobacter is obtained with magnesium salts; next come those of calcium, potassium and sodium; iron salts do not permit of its development.

The mono- salts of magnesium and of sodium give a better development than the corresponding di- salts; on the other hand with calcium salts we get equal results with either; monopotassic phosphate gives a slightly inferior development to that which is obtained with dipotassic phosphate. As regards artificial fertilisers, P_2O_5 phosphate soluble in citrate and in citric acid gives a better development than tricalcic phosphate.

On the whole a clear relationship is observed between the solubility of the phosphates and physiological utilization by Azotobacter. Further research to clear up these interesting questions is essential. A. F.

Sources of error in the determination of phosphoric acid by the "Molybdate-Magnesia" method.

MC CANDLESS, G. M. and BURTON, J. Q. (Mc Candless Laboratory, Atlanta, Ga.). *Industrial and Engineering Chemistry*, vol. 16, No. 12, p. 1267-1270, December 1924.

The writers start by pointing out that the great differences in results obtained by chemists in the determination of phosphoric acid, in products

of high P_2O_5 content, by following the official methods, whether gravimetric or volumetric, are principally due to the various quantities of hydrochloric acid which the chemists use for the purpose of neutralizing the ammoniacal solution of the yellow precipitate, in accordance with the instructions given in text books, without having the help of a suitable indicator to show the exact point of neutralization. The temperature at which pyrophosphate is calcined has also a great influence in the gravimetric determination.

From the results of practical experiments reported by the writers it appears that a solution may be accurately neutralized by the use of litmus paper and precise results obtained. If hydrochloric acid is added in such quantity as to exceed this point of neutralization, too high results are obtained. If, on the other hand, the solution is alkaline owing to the presence of free ammonia, we get too low results.

The writers in their note describe minutely in every detail the method successfully used by them to obviate the drawbacks indicated and obtain very precise results. L. M.

Potassic fertilisers.

The study of the equilibrium set up between water and potassium salts.

CORNEC, E. and HERING, H. Equilibrios entre el agua, el nitrato de potasio y el sulfato de potasio. *Caliche*, year VII, No. 7. Santiago, 1925.

Knowledge of the state of equilibrium between water and sodium salts (nitrate, chloride, sulphate) is fundamental for the scientific study of the Chile Nitrate industry; the Nitrate contains, in addition to sodium, other elements :— calcium, magnesium, potassium, which should be taken into consideration, unless found in negligible quantities, because they are accumulated in the soil water and thus enter into the cycle of nitrate formation. It is thought that the difficulties which are sometimes met with in extracting the potassium contained in Chile nitrate depend, at least partly, on the existence of a sulpho-nitrate of potassium which would correspond with certain conditions of solubility.

From the writers' experiments, on the other hand, it appears that within fairly large limits of temperature (from 3.3 to 100°) sulphate and nitrate of potassium cannot combine to form a double salt in the presence of water. Potassium so differs from sodium, ammonium and lithium which can form sulphonitrates.

Practically, the separation of nitrate of potassium from sulphate of potassium is effected in the same way as that of nitrate of sodium from chloride of sodium.

The study of cases in which sodium and potassium are present at the same time is thus simplified by the fact that a double salt between nitrate and sulphate of potassium does not exist.

A. F.

Potassic manuring of the vine.

DUSSERRE, C. and GODET, CH. Fumure potassique de la vigne, son influence sur le rendement et la qualité du raisin. *Annuaire agricole de la Suisse*, p. 639-643. 1925.

The addition of potassic salts to the ordinary manuring of the vine has had the effect of increasing the number of bunches of grapes which reached complete development and of slightly increasing their weight compared with the others.

The weight of sugar elaborated per acre was greater for the vines which had received the potassic manuring, but being spread over a considerably larger number of grapes the actual sugar percentage of the grapes decreased, which meant a lower alcohol content in the wine.

The total acidity and the proportion of tartaric acid were slightly higher in vines which had not received the potassic manuring.

As regards the comparative action of the chloride or sulphate salt the mean yield was greater with the former ; there is no appreciable difference as regards the components of the must and wine.

The taste, however, enabled the wines obtained by potassic manuring to be classed as better, without being able to differentiate between the two salts. A. F.

Iodine fertilisers for sugar beet.

UNGERER E. (Agrikulturchemisches Institut der Univ, Breslau). Ueber die wirkung einer Jodkali-Beigabe zu Zuckerrüben. *Zeit. f. Pflanzenernährung und Düngung*, vol. IV, n° 9, pp. 369-374. Leipzig, 1925.

STOKLASA had recently related the good results obtained by him by means of the addition of small quantities of iodine in the form of iodide of potassium in the growth of sugar beet, especially as regards the yield in roots.

In the experiments of UNGERE, on the other hand, which admittedly were not continued up to the full maturity of the plant, the addition of iodide of potassium during the 3 $^1/_2$ months of growth did not have the effects stated by STOKLASA and there was actually rather a decrease in the yield of roots and in the sugar content. A. F.

Substances aiding development.

Notes on " Promoloid Asahi ".

BOTTINI, E. (R. Stazione di Chimica agraria di Torino). Sul " Promoloid Asahi ". *Annali di Chimica applicata*, vol. 16, No. 1, p. 29-39. Rome, 1926.

" Promoloid Asahi " is a colloidal silicate of magnesium which is said to have the property of favourably influencing the growth of plants, improving their quality and increasing the yield.

Nowadays the absolute necessity of magnesium for all plants is recognized.

The principal functions attributed to it are those which it exercises :—

(1) on the circulation of phosphoric acid ;

(2) on the chlorophyll function ;

(3) on the formation and migration of starch and other carbohydrates ;

(4) on the formation of the protein substance of protoplasm ;

(5) on the development of nitrifying bacteria.

The writer's experiments show that " Promoloid " exercises a beneficial action in all soils, especially on their permeability and capillarity, while, except in occasional cases, it has little influence on the powers of drying and absorption.

In sandy soils it moderately decreases the permeability and slightly decreases capillarity, thus partly eliminating the drawbacks of the constitution of these soils. The power of drying remains almost unchanged and so also the power of absorption of salts, with the exception of chloride of ammonia, its absorption power for which is slightly increased. In clay soils permeability is much decreased, while capillarity increases, thus facilitating the movement of soil solutions from below to the surface. The powers of drying and absorption here again remain almost unchanged.

In calcareous soils the permeability decreases moderately, while the capillarity and power of drying remain unchanged. The power of absorption of chloride of ammonia becomes slightly greater.

In humic soils the permeability decreases largely and the power of drying and the capillarity increase considerably. The power of absorption of chloride of ammonia becomes greater and on the other hand that of nitrate of sodium decreases. The principal effect in these soils is a decrease of acidity. A. F.

Research on the influence of boron on plants.

CUSUMANO, A. *Le Stazioni sperimentali agrarie italiane*, vol. 58, No. 10-12, pp. 440-448. Modena, 1925.

Boron is found moderately diffused in plants and it even seems that in some it forms a regular part of the composition of certain organic substances. According to some it is found in soils containing tourmaline, according to others on the other hand it is brought into soils with artificial fertilisers and especially with Chile nitrate, guano and kainite.

The opinions of investigators on the action which boron exercises on plants are various, inasmuch as some consider that it has a stimulating effect, while according to others its effect is injurious.

The writer has made experiments with a mould (*Aspergillus niger*) and with pot cultures of lupins and beans.

Boron not only does not hinder the regular development of *Aspergillus*, but even helps it when given in doses of less than 0.010 %, the optimum dose being 0.005 %.

It has a similar effect on lupins and beans ; in these cases, the plants with the addition of boric acid or boraciferous earth also look better. The optimum dose of boron is that of 0.50 gr. per square metre of surface.

Identical results were obtained with experiments in the open field on tomatoes, wheat, potatoes and maize.

It should therefore be considered that boron acts as a stimulant for the absorption of soil elements useful to plants. A. F.

Tests with "Soilgro".

LEONARD, L. T. *Jnl. of Amer. Soc. of Agronomy*, Vol. XVII, No. 10, pp. 623-629. Geneva, N. Y., 1925.

Attempts are still made to produce a culture of soil bacteria which, when added to the soil, will greatly stimulate plant growth. The latest of these is "Soilgro", and the following data were obtained as a result of experiments made by the Bureau of Plant Industry, Washington. The material is sold in two metal containers, one holding the bacteria and the other "bacterial food".

The total number of bacteria in the Soilgro cultures tested was much lower than in the so-called bacterial food. Soil and manure samples gave higher figures.

The numbers of ammonifying and cellulose destroying bacteria were also larger in bacterial food, soil and manure samples than in Soilgro cultures. The presence of Azotobacter was not indicated. Legume bacteria were found, but in less number than in potting soil.

Nitrogen fixing by potting soil was superior to the fixation by a Soilgro culture.

The nitrification of ammonium salts in liquid and in soil cultures was better achieved by potting soil than by any of the Soilgro preparations.

Soilgro showed no superiority in the production of radishes, either in the stimulation of germination, earliness of crop, or weight of crop collectively or individually. Tests made with peas were also negative. Two tests on lawns did not produce results favourable to Soilgro. W. S. G.

Communications.

An International inquiry regarding the Control of Fertilisers. — The International Institute of Agriculture has just been making an International inquiry regarding the control of fertilisers and fungicidal and insecticidal products.

This inquiry, in pursuit of which a questionnaire was sent to countries who are members of the Institute and to numerous other correspondents, will serve as a basis of the report of Professor Jelinek for the control of fertilisers in the various countries. It is a consequence of a decision of the International Commission for the Study of Chemical fertilisers, a decision ratified by the VIII General Assembly of the Institute.

The questionnaire contains some fifteen questions on the existence and application of control methods (methods of analysis, etc.) regarding fertilisers,

fungicides, insecticides, and other chemical products utilized in agriculture. The International Institute should thus be able to collate information valuable for improving the methods and control services of all countries.

One extremely useful practical result for agriculture should be the possibility of making uniform and internationalising the chemical and other control methods used, a step calculated to facilitate business and to safeguard agriculture.

Conference for propaganda in favour of nitrogenous fertilisers. (Biarritz - France -, 27 and 28 April 1926). — On the joint invitation of the British Sulphate of Ammonia Federation of London and of the Stickstoff-Syndikat of Berlin a certain number of persons distinguished in agronomic science and the nitrogenous fertiliser industry met at Biarritz, at the Hotel Regina on the 27th and 28th April 1926 to study questions relating to propaganda for the use of nitrogenous fertilisers.

The meetings were presided over by Mr. D. Milne WATSON, President of the British Sulphate of Ammonia Federation. Among the papers given, all by eminent specialists of the fertiliser industry, that of Dr. J. BUEB of the Stickstoff Syndikat of Berlin on the *Determination of price and creation of new forms of nitrogen fertilisers as factors in propaganda* is worth noting. He shewed that in Germany particularly the development of nitrogenous fertilisers was due to the fact that up to 1923 the price of these fertilisers was fixed by the State. With the fall in the value of the currency, nitrogen could thus be placed at the disposal of agriculturists at an extremely low price. The consumption of nitrogenous fertilisers has consequently become considerable in Germany. Thus German agriculture consumed in 1924-1925 335 000 tons of pure nitrogen, against 240 000 in 1923-1924, a fact that demonstrates the result of the fixing of a very low sale price on developing the use of fertilisers.

Dr. BUER went on to mention the creation in Germany of numerous new fertilisers, notably the BASF Potash-nitrate of ammonia, the BASF Leuna nitrate (sulpho-nitrate of ammonia) among nitrogenous fertilisers, to mention only the latest.

The " Diammonphos BASF " is a pure diammoniacal phosphate, $(NH_4)_2HPO_4$ containing 19 % of nitrogen and 47 % of phosphoric acid. The " Leunaphos BASF ", a mixture of sulphate of ammonia and Diammonphos, which contains 20 % of nitrogen and 15 % of phosphoric acid is very suitable to the German cultural practice which demands a fertiliser containing nitrogen and phosphoric acid in the proportion of 1 to 0.75.

Lastly a new fertiliser " Leunaphoska BASF " has been made for export to countries where it is not possible to recommend the use of separate fertilisers, owing to present lack of information on the various requirements of their soils.

Leunaphoska, suiting all soils, meets this aim. It contains 13 % of nitrogen, 10 % of phosphoric acid and 13 % of potash. The presence of phosphoric acid and potash assures the action of the nitrogen.

Mr. F. C. O. SPEYER, General Manager of the British sulphate of ammonia Federation next spoke, strongly supporting Dr. BUER's views on developing the use of fertilisers by lowering the price and then favouring such use in various situations by creating efficient types of fertiliser.

He also showed that the producers were combining for the sale of all nitrogenous fertilisers without distinction of methods of manufacture.

Mr. SPEYER spoke of the fact that agriculturists decrease their purchases of fertilisers for a long time after they have suffered from a fall in agricultural produce, and suggested therefore that the manufacturers should resist the temptation to raise prices on account of temporary agricultural prosperity.

Professor Dr. HERMANN WARMBOLD of Berlin in his communication :— *The conditions and objects of the use of nitrogen in relation to propaganda*, recalls the difficulty which is found in fixing a general relation between the quantity of fertiliser used and the increased yield obtained. This relation is constantly variable. Nevertheless it may be remarked that, other things being equal, it is noticed that the increases in yield diminish according as the latitude increases.

Moreover when the doses of fertiliser are increased, the return per unit of fertilising element used diminishes, Lastly little is known regarding the relations between the use of fertilisers and the yields in tropical regions.

We cannot follow up this speaker's numerous ideas or recollections of data concerning the advantages of the use of fertilisers, economizing ground and manual labour.

M. J. GALLAND of Paris and Mr. T. H. J. CARROLL of London took part in the discussions. Prof. Dr. ERWIN BAUR, Director of the Institute " für Vererbungslehre Landwirtschaftliche Hochschule " of Berlin spoke of the *Creation of new types of plant species capable of responding to maximum dressings of fertilisers*. He recommended the selection of varieties which would absorb fertilising material in large amounts, a selection to be made in plots specially charged with fertilisers.

Prof. Dr. H. NILSSON-EHLE, Director of the Sud Research Station at Svälof Sweden, and Professor of Genetics at the Lund University at the same place, gave a lecture on *Nitrogen Fertilisation and Cereal Breeding*, showing the necessity that the science of cereal breeding should remain firmly faithful to the aim of the highest productivity in combination if possible with the maximum stiffness of stem. He passed in review the principal problems of cereal breeding, drawing attention to the most important desiderata, such as, among others, precocity and resistance to diseases, two characteristics essential in intensive cultivation.

Dr. Russel OAKLEY of Washington and Dr. J. A. LIPMAN of New Jersey took part in the discussion. Prof. Dr. Karl BOSCH of Ludwigshaven spoke of the importance of propaganda for the use of fertilisers.

PROCEEDINGS OF THE INTERNATIONAL ASSOCIATION OF POULTRY INSTRUCTORS AND INVESTIGATORS

Papers.

Investigations concerning the Operation of Foods containing Herring-pickle and bits of Herring for fowls, a Contribution to the Question of Kitchen-salt poisoning in Poultry.

AV. ERICH, Dissertation from the Tierseucheninstitut der Universität Leipzig, Direktor Prof. Dr. A. BER. 26 pp. Leipzig, 1925.

Feeding tests with fresh, unwatered herring have shown that in general only small quantities were eaten by the fowls tested. Afterwards, with the exception of thirst and a slight degree of diarrhoea, no appearances of illness were observed.

From the experiment with herring and herring salad watered for 24 hours it appears that in this form also only relatively small quantities of herring were eaten, which in no case contained a dose of kitchen-salt fatal to the fowl.

It is to be assumed that with the cases of herring-pickle poisoning observed in practice, in many cases it was a question of pickle which was already decomposed. On the decomposition of herring-pickle there arises, side by side with other decaying products, the specific smell of trimethylamin dependent on herring-pickle.

4.0 gm. of kitchen-salt are capable of killing a fowl weighing 1000 gm., but only if, during the first 24 hours, no water can be taken in. If a sufficient quantity of water is available, then 4.5 g. of kitchen-salt per kg. of body weight are digested in some cases without injury, whereas with fowls possessing a smaller power of resistance this quantity will cause an illness ending in death. Fresh herring-pickle, herrings and parts of herrings not in process of decomposition, only operate fatally through their content of kitchen-salt.

Avian Variola and Vaccine. Immunity in Avian Variola.

J. BASSET. *Comptes rendus des Séances de la Soc. de Biologie.* Paris, Vol. XCIV, No. 3, p. 525. 1926.

Vaccine excepted, animal variola is considered as rather narrowly specific and only suceptible of being transmitted to the species which shows the spontaneous discease. BASSET has not succeeded in infecting mammals e. g. cow and rabbit with chicken variola.

The experiments of the writer with vaccine virus permit of the conclusion that vaccine virus and avian virus are different, since animals immunized against one virus retain all their natural receptivity for the other.

To obtain local immunity *i. e.* immunity of the receptive tissues it is by no means necessary to introduce the virus into these tissues.

A Case of poultry spirochaetosis in Germany.

Dr. R. BERGER. *Deutsche tierärztliche Wochenschrift*, No. 10, p. 169, 1926.

In the Institute in 1924 spirochaetosis was observed for the first time in poultry here in two 6 months old pullets. An exact description of these cases follows, also a summary of literature.

In blood preparations coloured according to MAY — GRÜNWALD — GIEMSA, numerous spirochaetes were found. Blood samples prepared in accordance with the BURRI Indian ink process also showed the presence of numerous spirochaetes.

These can also be easily seen in samples taken from the liver, spleen and kidneys. After the passage thorough the blood stream of the spirochaetes the appearance of illness in the hens subsided more and more, and the number of spirochaetes in the blood decreased constantly.

It was not possible to discover a definite source of infection which would explain the outbreak of spirochaetosis in the pullets.

Pigmented Testicles in Poultry.

Dr. HEINRICH BITTNER. *Berliner Tierärztliche Wochenschrift*, No. 34, page 533. Berlin, 1925.

Dissection has revealed the presence of dark coloured testicles in poultry. This striking and peculiar appearance is mentioned neither in the modern text-books on the anatomy of poultry, nor in the descriptions of poultry diseases.

It is to be traced to actual pigmentation by melanotic pigment. BITTNER describes thoroughly histological investigations, and gives illustrations of paraffin sections. The histological findings allow it to be understood that the dark colouring of the testicles is caused by melanophores mainly branching, rarely spherical, which lie in the intertubular tissue and in the tunica albuginea. The core of these melanophores is similar to that of the Leyden intermediate cells.

No explanation can be given of the pigmentation described. The pigmentation of one or both testicles, often observed with singing birds, also occurs with poultry.

In conclusion BITTNER gives an exhaustive bibliography of 83 numbers.

The Poultry Industry in 1925.

EDWARD BROWN. Essex Street 20-21. London, January 1926.

There has been a considerable increase in the number of poultry kept in the United Kingdom within the last few years. One of the most satisfactory

features during 1925 was the growing interest taken by farmers in egg and poultry production. The poultry production value was in 1925 greater by 47.85 % than the wheat crop, 112.88 % above the barley crop, and 76.63 % more than the oat crop in the same year.

During the year under review the National Poultry Institute Scheme has made marked progress and the central Institute at Harper Adams, Newport, Salop, will soon be completed. Important work is in progress dealing with diseases of poultry.

The production of table poultry has recovered to a large extent. During the year exhibitions have made considerable advance both in numbers and influence. It is most satisfactory to record the greater recognition of production value in the stock.

The author gives many figures about imports into England of eggs, live and dead poultry.

Action of the sexual Hormone on the Comb of Gallinaceae.

Ch. Champany. *Comptes rendus des séances de la Société de Biologie.* Paris, Vol. XCIV, No. 5, p. 311.

1) Graft of the genital gland in the comb of the capon. Champy introduced a thin slice of testicle into the combs of 3 capons. The birds showed a regrowth of the comb. The comb became equal to that of a normal cock.

2) In capons subjected to testicular transplanting the muco-elastic tissue quickly starts again to swell 2 or 3 weeks after grafting under the skin of the back. This tissue therefore shows well sensibility to the sexual hormone.

A simple phenomenon of imbibition and rejection of sensitive tissue seems therefore to be the origin of other modifications which are observed in the comb.

The Feathered World Year Book 1926.

R. and O. Comyns-Lewer. *The Feathered World.* 9 Arundel Street, London.

The Feathered World has this year surpassed every thing published in this business for years. In a very sound book of 560 pages are published different interesting poultry problems and a number of good photos. Some introductory notes by S. H. Lewer and the first article, on the Poultry Industry in 1925, by Edward Brown show us the standpoint of the British Poultry Industry during 1925.

Among the articles are : The Diseases of Poultry, The " addled " Egg, Yearly activities among the Bees, Economically successful Breeds of Rabbits for Fur production, How to make money by rearing Angora Rabbits for Wool production, A Year on the Poultry Keeper's Garden, Things seen and noted by the Utilitarian. Follows a description of about 120 different

breeds of Hens, Ducks, Geese and Pigeons by specialists. A very useful Handbook indeed for the poultry keeper.

Fresh and Preserved Eggs.

FILANDEAUR and VITOUX. *Annales de Falsifications*, November 1925. Ref. *Recueill de Médécine Vétérinaire*, Paris, Vol. CII, No. 1, p. 40, 1926.

The fresh egg cooked hard, easily taken out of the shell, presents an air chamber of very small dimensions, the white is opalescent, very homogeneous and elastic, the yolk generally well centred is rarely apparent and never in contact with the shell, the smell is fresh.

When eggs preserved by processes based on stopping the pores of the shell (eggs in waterglass) are cooked, 9 times out of 10 the egg cracks when it reaches about 70°, and it does not crack at random like an egg whose shell is defective, but always breaks along a line following the direction of its larger axis. This characteristic appears to be specific.

The shell of the hard egg is difficult to remove, the air chamber generally reduced, the yolk is apparent being displaced towards the points and often in contact with the shell, the white is not firm but slightly elastic often dividing into two or three layers.

With eggs from cold storage it is often noticed that when placed in water they stand upright on one end (sometimes some are found to float). When cooked they show an air chamber generally of considerable size (sometimes $1/8$ or even $1/4$ of their volume) and of irregular shape. The yolk, displaced, is apparent and in contact with the air chamber, the white of unpleasing appearance, sometimes greenish or pink, is flabby, sometimes granular ; on breaking it becomes divided into several layers more or less concentric, the smell is disagreeable.

Eggs preserved by the Lescard process are more tricky to recognize. Eggs in which the air chamber is very reduced in size are, when cooked, difficult to get out of their shells. If the shell is removed with some care a curious and characteristic phenomenon is sometimes observed. In consequence of the effect of the vacuum to which the egg has been subjected, the hyaline membrane is detached from the shell and in the small cavity thus formed is found a drop of water which has either entered during the boiling or has resulted from a phenomenon of dialysis.

The white is fairly firm and more normal in appearance, but it still divides into concentric layers. The yolk is apparent and displaced towards the narrow end.

The authors have also noted the character of the broken egg. Displayed on a plate, the fresh egg shows a dense homogeneous white with a very slight more liquid border. With preserved eggs two layers are distinctly noticed in the white, one of dense consistency surrounding the yolk and the other much more liquid envelopping the former and spreading on its edges. Its importance increases with the age of the egg. If on the other hand the white is collected in a test tube, it is noticed that that of the fresh egg, without being limpid, is homogeneous, while that of the preserved egg often shows granules of an albuminous substance.

Chickens to the Fore.

Dr. B. M. Gonzales. *Philippine Free Press.* Manila, November 7, 1925.

In the Philippines there is a considerable agitation about keeping out the Chinese. But that is only one phase of the problem. Why should the Philippine people pay over one million pesos to China each year for such a simple matter as eggs, when that amount might as well be kept at home? The College of agriculture at Los Baños now gives a full description of the improved Cantonese chickens of Los Baños, which lay an average of 115 eggs a year.

The Cell forms of the loose binding-tissue of Birds.

R. Herrmann. *Deutsche Tierärztliche Wochenschrift.* Hanover, p. 111, 1926.

Views on the occurrence and signification of the cell forms of the loose binding-tissue are not yet clear. Literature gives little information on the binding-tissue of birds. In his investigations Hermann has made use of the subcutaneous binding tissue of sparrows. He has found: (1) Fibroblasts, (2) Mast cells, (3) Clasmatozytes, according to Maximow called "quiescent travelling cells", (4) Small amoeboid travelling cells, (5) Plasma cells. In the binding-tissue of sparrows he was not ableto find the eosinophillic cells described in the binding-tissue of mammals.

On the Significance of Small Stones in the Gizzard of Fowls.

Jaeckel, Y. Dissertation from the Institute of Animal Physiology of the Agricultural High School at Berlin, Director Prof. Dr. Manold. *Cremers Beiträge zur Physiologie.* Vol. III, No. 1-3. Verlagsbuchhandlung von Richard Schoetz, Berlin SW 48, 1924.

There is given a method of operation which enables gizzard stones to be entirely removed from the muscular gizzard of the fowls.

The frequency of the movements of the gizzard of the fowl is not influenced by the removal of the small stones contained in the gizzard.

The gizzard pressure, that is, the power of the gizzard contraction, also remains the same when the gizzard is without stones.

By careful feeding, fowls without stones can be kept alive for months, but in the foregoing tests success in maintaining such animals, grain fed. in a condition of even, nourishing weight, was not attained.

The little stones found in the gizzard of the fowl have no share in the formation of egg shell.

Contribution to the Macroscopic and Microscopic Anatomy of the Intestine of *Gallus domesticus*, with Special Consideration of the Intestinal Villi.

A. Krüger. *Deutsche Tierärztliche Wochenschrift,* p. 112. Hanover, 1926.

These investigations dealt particularly with the intestinal villi of poultry, comparing them with those of man, dog, cattle, sheep, pigs and geese.

The length of the intestinal tract of gallus domesticus has left nature plenty of room for action. The type of food etc. influences the length of the intestinal canal. The length of the intestine, with fully grown fowls, varies approximately between 260 and 170 cm. The width of the intestinal canal varies likewise.

The mucous membrane is furnished with villi up to part of the caecum from the gizzard to the cloaca.

Noduli lymphatici aggregati appear in the duodenum, not in the colon, but on the other hand are found in the jejunum and ileum at intervals of about 50 cm.

Noduli lymphatici solitarii are missing in the duodenum and the colon, but otherwise are to be met with in the whole course of the small intestine.

A further peculiarity is the appearance of structural folds on the mucous membrane of the blind intestine and the colon.

In the hen, without the width of the intestine being much altered, the ileum continues straight through the colon, quite independent of the caecum. The blind intestines are blind sacks of the colon, and are in no relationship to the embryo. At the entrance to the colon and penetrating into it is formed a ring-fold, valvular coil.

A thorough study is made of the diverticulum caecum vitelli. The embryological development of the intestine of the hen is exhaustively worked out. The differences in the microscopic formation of the villi, and folds are brought into great prominence. The form and size of the villi vary considerably in the different sections of the intestine. They form rows of funnels or sluices, which run at an angle of about 20 degrees to the direction of the intestine, and wind themselves in a spiral down the intestines.

Has the Pepsin of Poultry the Capacity of Penetrating Vegetable Cells, and what is digested from these ?

KRÜGER. *Landwirtschaftliche Jahrbücher.* Vol. LXI, No. 6, p. 909.

The ferments pepsin and trypsin have the capacity of penetrating vegetable cells and digesting albumen from them ; fat remains in spite of the loosening of the structure of the cell wall in the cells.

In the gizzard of the hen the glutinous cells are not altered by the hydrochloric acid of pepsin ; only plasmolysis and change of colour are shown with fresh vegetable cells. The peculiar proteolysis takes place first in the intestine, after the food has been previously mechanically reduced in the gizzard. Fresh cells of elodea, grass, lettuce and cabbage appear digested uninterruptedly in the excrement. Glutinous cells of oats and wheat are often thoroughly digested, or considerably decomposed ; by previous kibbling of the grains, the digestion can be carried still further, indeed starch appears in the residue ; cooking the grains reduces the digestion of the glutinous cells.

What this amounts to in practice is that poultry is capable of preparing vegetable cells in a mechanical way for the penetration of the gastric jui-

ces; pulverizing or cooking of the grains can be done without damage. The albumen contained in the grain fodder is to a great extent digested from the cells and resorbed, the fat, so-called, of the cells remains in the cells and escapes resorption.

Coccidiosis of the Rabbit or Big Belly Disease.

Dr. Em. Leymen. Federation Nationale des Sociétés d'Aviculture Ministry of Agriculture. Brussels, 1926.

An interesting paper on coccidiosis of the rabbit. Description of coccidia, of symptoms of the disease, prophylaxis and a type of hutch in which the excreta are automatically removed after their ejection, so doing away with the necessity for litter to which the excreta always remains adherent.

Avian Plague.

Em. Leynen and R. Willems. *Annales de médicine vétérinaire*. Brussels, Dec. 1925.

A very interesting paper on avian plague dealing with the history of this disease and giving very fine illustrations.

In Belgium Dr. Leyman noticed the disease on the 30th May 1925. It had broken out following a purchase of foreign pullets.

The disease made considerable ravages. The infected bodies had been thrown into the la Nèthe river and had contaminated the drinking water. With the object of controlling the importation into Belgium of foreign poultry affected with contagious diseases, a Royal Decree of the 18th October ordered the controlling veterinary officer to send the bodies found in the crates to the laboratory in order to diagnose the cause of death. Meanwhile the poultry remained in quarantine.

As a result of the new regulation on three occasions a diagnosis of "Avian plague" and twice a diagnosis of "Cholera" has been given out of six despatches of dead poultry found in the crates at the import offices, and on that account this poultry has not been allowed to enter the country.

The Poultry Industry of Wales. A Survey of Stocks, Methods and Prices.

J. Morgan Jones. Agricultural Economics Department. Aberystwith 1925.

This booklet of 50 pages gives information, which explains many of the reasons why the poultry industry has not made greater progress in Wales, where the small farm conditions are generally found to be most favourable to its development.

The relative production, save in the case of geese, is much lower than in England. Experience has proved that the bulk of producers if left to themselves will take few, if any, measures to ensure the marketing of fresh eggs.

Vitamin A Content of Fresh Eggs.

MURPHY J. C. and BREESE JONES D. (Bureau of Chemistry U. S. Dep. of Agriculture). Vitamin A Content of Fresh Eggs. *Jnl. of Agricultural Research*, Vol. XXIX, No. 5, pp. 253-257, 4 fig. bibl. Washington D. C., 1925.

Feeding experiments have shown that in 0.50-0.75 g. of new laid egg a sufficient quantity of vitamin A is given to allow of the normal growth of young rats. A smaller quantity (0.25 g.) was shown to be sufficient to cure advanced cases of Xerophthalmia. A. F.

Contribution to the Question of the Injuriousness of Steeped Corn as Poultry Food.

NIEBER, CARL. Dissertation of the Tierärztlichen Hochschule Berlin, p. 9. 1925.

First feeding experiment with steeped grain.

4 series of tests, each with 10 hens, the duration of test being 14 days. As the medium for soaking there were used Germisan, AZ 3, Segetan-neu, agfa pickle, Upsulun, Urania seed pickle, Blue stone, Calimate, Corbin, Fusel oil, Tillantin B and Tillantin C.

The quantity of corn administered amounted to 150 g. per head per day. With one half of the animals experimented on, this quantity was given from the first day onwards; with the second half 50 g. were given on the first day, 100 on the second, and not until the third day were 150 g. given and continued. The hens took all the scattered grain willingly, obviously suffering no disturbance to health. Only the grain steeped with fusel oil they took unwillingly the first day of feeding; afterwards they got accustomed to it.

Eggs from hens which had fed on grain treated with corbin had a sharp tar-like taste when boiled.

When feeding with grain steeped in Blue Stone special caution is recommended.

Second experiment with pickling material in Solution:

Each 2 hens had 2 % and 5 % solutions of germisan, upsulun and calimate administered by the throat-probe. The animals died after taking about 0.2 g. quicksilver, or about 0.5 g. chlorophenol-quicksilver, or about 0.1 g. phenol and 0.08 g. formaldehyde.

The experiments admit of no conclusion as to the danger of feeding other agricultural domestic animals in such a way. The question as to the operation of steeped grain on other kinds of fowls, as also on other agricultural domestic animals, requires still further explanation.

Some new Facts regarding the Grafting of ovaries in the Domestic Cock.

PÉZART, SAND and CARIDROIT. *Comptes rendus des Séances de la Société de Biologie*, Vol. XCIV, No. 8, p. 520, 1926.

From 3 cases it results that the survival of ovarian grafts made in the cock may last several years during which the bird remains fertile and endocrinian.

Moreover the evolution of the follicles does not present any real anomalies when the ovarian tissue is transferred from the hen to the cock.

Lastly in one case the duration of the transplant was obtained in spite of the presence of the testicular mass of the bird operated on, that is to say, under conditions which we usually consider as very unfavourable.

Studies on Poultry Plague.

Dr. W. PFENNINGER and Dr. E. METZGER. *Schweizer Archiv für Tierhailkunde*, Zurich, p. 2. January 1926.

In the year 1925 there was a considerable outbreak of poultry plague in Switzerland. The circumstances are evidently connected with the importation of poultry from Upper Italy, where in the previous spring and summer this epidemic spread very greatly.

Cases of natural and experimental poultry plague are described in detail.

Poultry Diseases Again.

Journal of the American Veterinary Medical Association, Vol. LXVIII. No. 5 p. 543. February 1926.

All of the papers of this number are devoted to avian diseases, which are dealt with in the following articles:

Fowl Pest in the United States by J. K. MOHLER, Washington.

Fowl Pest by E. STUBBS, Harrisbury.

Infectious Bronchitis of Fowl, by J. K. BEACH, Berkeley.

The etiology of this disease has not yet been determined. It is really transmitted to healthy fowls by the introduction into the trachea of material from the trachea of an affected fowl.

Chicken-pox virus is sometimes present in the exudate of the larynx and trachea of diseased birds. The importance of this virus in the etiology of the disease however is not definitely determined. Lesions very similar to those of infectious bronchitis were produced in one of two fowls inoculated by the introduction of chicken-pox virus into the trachea.

Avian Haemorrhagic Septicemia by J. W. PATTON.

Studies on Salmonella pullorum, by E. REBRASSIER.

Conclusions (1) In the identification of *S. pull.* it is essential in addition to studying its special morphological characteristics, to ascertain its fermentation activities in dextrose, mannite, lactose and maltose.

(2) There exists an interagglutinability between *S. pull.* and other intestinal organisms. It is not safe, in applying the agglutination test for *S. pullorum* infection to use a titre lower than 1-100.

(3) The results obtained in the interagglutinability of E. *sanguinaria* aod *S. pullorum* indicate that the agglutination test for the latter is not specific, as serum from *E. sanguinaria* has a high agglutinative titre for *S. pullorum* antigen.

(4) It is evident that the blood of chickens normally contains agglutinins for *S. pullorum*. The normal agglutinative titre is 1-10.

(5) The so-called pseudo-agglutinations in the application of the macroscopic agglutination test for S. *pullorum* infection can be controlled by use of antigens which have no phenol added as a preservative.

Neuritis in chickens by L. P. DOYLE.

Summary: In this disease we have a definitive affection of the nervous system which usually produces recognizable gross lesions. The nature of the specific cause is still obscure. Injection and feeding experiments gave negative results during the periods of observation.

Studies in transmission of bacillary white diarrhoea in incubators, by HINSHAW, UPP and MOORE.

B. Aertryche injection in canaries and parrots by T. K. BEAUDETTE.

B. Aertrycke as the etiological agent in a disease affecting squabs by T. K. BEAUDETTE.

Plan for handling avian Tuberculosis, by T. E. MUNCE.

An Oubreak of Fowl Cholera by A. K. GOMEZ.

Poultry World Annual 1926.

The Poultry Press Ltd. Link House, 54 Fetter Lane. London E. C. 4.

A very interesting book with good illustrations and a long list of articles by specialists. It contains the following articles :—

The Poultry Yard, Month by Month.
Leg Colour and Quality in Exhibition Stock.
Buttercups in the Backyard.
The Old English Pheasant Fowl.
The Sussex Fowl.
Hygiene and disease.
The Black Minorca.
The Beautiful white Plymouth Rock.
The early Baby chicks.
Feeding for Eggs.
Growing the laying Pullets.
Tuning up the Poultry Runs.
Pullets on free range.
Whence comes the Chick?
The Management of Poultry during Hot Weather.
Turkeys as farm stock.
When the eggs begin to fail.
Which are the best layers?
Keep down the red Mite.
What sprouted oats mean to the egg producer.
Growing healthy chicks.
Milk as Food for chicks.

A complete Treatise on Aviculture.

V. PULINCKS EEMAN. Brussels. Chasse et Peche. Avênue de la Toison d'or. 1922.

A monograph on the principal breeds, giving to breeders special knowledge for acquiring the best breeding birds and information on breeding so

as to obtain the best results. A book with very fine coloured illustrations.

Poultry Breeds Illustrated.

V. PULINCKS-EEMAN. Chasse et Pêche. Brussels, 1924.

This third edition gives, in addition to all the standards of the breeds represented, a description of breeds which have recently come into favour with poultry breeders.

In a large number of pictures the artist has not confined himself to drawing the sketch of the bird represented, but has indicated the principal details of the markings and patterns.

Contribution to the Digestibility of Albumen in Poultry.

REATZ. Arbeiten der Lehr- und Versuchanstalt für Geflügelzucht, Halle a. d. Saale Cröllwitz, Prof. Dr. Römer. *Deutsche Landwirtschaftliche Geflügelzeitung*, 28th year, No. 46, 13 August 1925.

KELLNER established the prime importance of the digestibility of feeding material dealing only with cattle, LEHMANN with pigs. Poultry conditions were not much considered. Experiments in food assimilation by poultry did not take place until the end of the last and the beginning of this century, when undertaken by LEHMANN, VOLTZ, DIETRICH, and especially LÖSSL. Figures of digestibility of a few foodstuffs:

	According to KELLNER for large cattle	According to LÖSSL for poultry
Wheat	80 %	26.67 %
Maize	83 %	24.10 %
Barley	77 %	14.92 %
Oats	79 %	18.64 %
Soya Bean	94 %	36.05 %
Fish-meal	92 %	91.90 %
Meat meal	97 %	82.35 %

Experiments on the digestibility of albumen with shredded oats, dry yeast and dry buttermilk with fowls:

The oats albumen shewed	36.12 %	digested
The dried yeast albumen	42.68 %	»
The dried buttermilk	74.66 %	»

Dried yeast and dried buttermilk did not prove so digestible for fowls as fish-meal and meat-meal.

Type and Size of Fowls (Italians, Brahmas and Game-birds).

RICHARDSEN. *Deutsche Landwirtschaftliche Tierzucht*, No. 2, p. 4, 1926.

In judging the illustrations of animals made to show individual breeding performances, especially for the continuous determination of the status of

the breeds, in various spheres, in the technical journals, which are used in all directions and accessible to all breeders, the observer can only satisfactorily grasp the type. In particular, type builders, without numerous particulars regarding the sizes and weights of the animals concerned, can only imperfectly realise their object.

The second Annual International Poultry Blue Book. An International Summary of Egg-laying Contests of the World, during the Contests Year 1924-1925.

W. E. ROBINSON. *The Edward F. Hartmann Co.* Springfield, Illinois, 1925.

To make egg laying contests valuable there must be opportunity for intelligent comparison. This can be accomplished only by standardisation. Canada has set the pace and it is to be hoped that all other countries will conform. Housing, rations and management can well be left to each contest and would in effect bring about a contest of contests.

The rule is followed of reporting the best 20% of the pens and an equal number of best hens without reference to breed in each contests. Also a report is made of the best pen and best hen of each breed not having a representative among the high producers.

Experiments on Close Inbreeding of Poultry.

FREIIN VON SCHLEINITZ. *Deutsche Landwirtschaftl. Geflügelzeitung*, No. 44, 1925.

Six strains were examined for brooding capacity, mortality, growth, egg production, maturity and propagation. The following results were arrived at:—

(1) Brooding capacity: By inbreeding the brooding capacity declined in all 6 experimental strains. The brooding capacity of the parent stock amounted to 79 %; after 3 generations of brother-sister inbreeding it was only 22 %.

2. Mortality: Inbreeding probably increases not only the mortality of the young stock but also that of the older stock. The reason is in general the smaller life capacity, partly also the great reversion to ancestral illnesses, and an increase of hens showing the results of recessive inherited factors of specific abnormalities, such as prolapse of the oviduct.

(3) Growth: The rate of growth sank both for the inbred and the control chickens.

(4) Egg Production: Yearly produce of the parent strains 152. In the first generation of the brother-sister inbreeding there was a decline in productivity in all the 6 strains, about 57% of the average of the parent. The winter egg production of the inbred strains sank from 32 eggs in the parent generation to 5.7 in the second. With the control animals the winter egg production remained constant at about 18 eggs.

(5) Maturity: The close inbreeding caused a great decline of fertility in the case of the mated fowls, which does not occur in the same animals in the absence of inbreeding; we here encounter a retardation of the development of the embryonic life.

The economical significance of German Poultry Breeding.

Dr. G. SCHÖNBORN. *Berliner Tierärztliche Wochenschrift*, p. 159, No. 10, March, 1926.

Until 1900 poultry was not counted in the general census of cattle, and was not valued very highly. It is now recognized as of economic importance from the State's point of view, and Germany cannot do better than make use of American experience, and adapt it to German conditions. The Americans have shewn that continued calculations are the starting point in poultry keeping. In Germany also a tireless energy is being displayed in the economical perfecting of poultry breeding.

The exact knowledge of American working methods introduced after the war, partly by the return home of German-Americans, has had a great influence on poultry keeping. The poultry breeder demands protection for the home egg trade against foreign dumping.

The organizations are mentioned which are devoted to the furtherance of poultry breeding in Germany.

Simultaneous Infection of a Bird by 17 species of Intestinal worms.

K. J. SKRJABIN. *Comptes rendus de la Société de Biologie*. Vol. XCIV, No. 5. p. 307, 1926.

The writer has up to the present time made 6500 dissections of different birds at the helminthological laboratory at Moscow to enumerate the fauna of parasitic worms. He found at Novotscherkassk (Don) in a drake killed in October 1919 the following species of intestinal worms :—

A. Nematodes.

1. *Schistogonimes varies* Br. 1 in the rectum.
2. *Prosthogonimus* sp. Br. 1 in the rectum.
3. *Metorchis xanthosomus* Crzil. 1 in the duodenum.
4. *Bilhorziella polonica* Row. 5 in the blood.
5. *Eschinostoma revolutum* Tröhl. 3 in the small intestine.
6. *Strigea gracilis* Tröhl. 51 in the small intestine.
7. *Trachophillus sisovi* Sky 2 in the trachea.
8. *Fimbriaria fasciolaris*, 56 in the small intestine.
9. *Hymenolepis carenula*, 38 in the small intestine.
10. *Hymenolepis compressa*, 24 in the small intestine.
11. *Hymenolepis anatina*, 2 in the small intestine.
12. *Hymenolepis collaris*, 3 in the small intestine.
13. *Amidostonum anseris*, 3 in the cuticle of the gizzard.
14. *Echinuria uncinata*, 16 in the tumours of the ventricle.
15. *Tetrameres pisipinus*, 7 in the ventricle.
16. *Capillaria anatis*, 3 in the caecum.
17. *Polymorphus minutus*, 4 in the rectum.

In all 251 specimens.

Which breeds of poultry in their present standard form ensure high egg production?

SWEERS, RECKHARDT, ULRICH, ROMER, WEINMILLER, JESS, WIENINGER, MEYER, *Deutsche Landwirtschaftliche Geflügelzeitung*, No. 18, 1925.

The laying type demands of a hen in the first place a roomy body. The breast and egg area should therefore be deep, the back be horizontal, and not fall towards the hind part. In the laying type the distance of the pelvic bones from the breast-bone, and of the pelvic bones from each other is wide, in the useless type on the contrary it is short. In Germany the following have proved the best layers: American Leghorn, followed by Rhinelanders, particularly where the hens possess a good laying build and consequently guarantee a good output, then the Westphalian "Totleger" whose producing form, in spite of the sporting breed, still remains true to type. Brackels and Moewen are already too easily bred, Wyandottes have suffered loss in laying capacity through too much crossing with game birds. To-day two directions of breeding stand out, namely, the game type, ball shaped, similar to the Orpington, and the useful type with slender but nevertheless deep carcase. Rhode Islands and also Sussex to some degree have shown themselves to be good layers. Orpingtons have altered considerably through climatic influence in East Prussia, having become lighter and similar to Rhode Islands.

On the Agglutinative Relationship of Hen Typhus Bacilli towards Human typhus Bacilli.

GIICHI TAKAYANAGI. *Centralblatt für Bakteriologie*, I Section Original, Vol. 98, No. 1-2, 1926.

Summary.

(1) Hen typhus bacilli agglutinate very strongly in typhus serum, often up to titration.

(2) Still, it was observed that amongst many typhus sera, there were some which hen typhus bacilli could not agglutinate.

(3) Typhus bacilli agglutinate in hen typhus serum as strongly as homologous bacteria. Nevertheless I found amongst typhus species some which would not agglutinate in them at all.

(4) If animals were previously treated with the first species, then sera were obtained which influenced hen typhus very strongly, up to titration. On the other hand, sera were obtained which did not affect hen typhus bacilli at all, when rabbits were previously treated with the latter species of typhus bacilli.

(5) When during the immunization of rabbits with typhus bacilli, hen typhus bacilli were examined often for agglutination, it was seen that hen typhus bacilli react more strongly at the beginning of the immunization in comparison with the main agglutination than at the end.

(6) Consequently I may well assume that the above observed fluctuation of agglutination of hen typhus bacilli in typhus sera is caused on the

one hand by the individuality of the typhus bacilli species, and on the other hand by the method of immunization.

Poultry Notes.

ALFONSO TUASON. The Government of the Philippine Islands. Manila, 1924.

One of the most important reasons why the Philippine chicken is of small size, a very poor layer, and lacking in uniformity is the fact that good fowls are not selected for breeding. TUASON here gives his pamphlet hints for the improvement of poultry keeping. He describes selection of male and female birds, proper feeding, etc. These points are especially valuable for the tropics. A short description of the most common diseases and some good drawings are also given.

Research on the Prevention and Treatment of Diphtheric Variola in Birds.

M. Y. VERGE. *Revue Générale de Médecine Vétérinaire*, Toulouse, Vol. XXXV, p. 65.

Avian diphtheria, contagious epithelioma and oculo-nasal catarrh are all the same disease and are caused by a single ultra-virus. The virus can be cultivated in vitro in symbiosis with the cellular elements. It is therefore a cytotropic virus which has an elective affinity for tissues derived from the ectoderm :— skin, nervous systen, buccal and nasopharyngeal mucous.

An intrinsic pathogenic value had for a long time been attributed to secondary germs, but an experiment of VALLÉE and CARRÉ shows in favour of the process that reproduction was able to bring about. These writers indeed have noted that a culture of staphylococci is capable of absorbing aphthous virus, and being then inoculated on a new and sensitive subject the culture gives foot-and-mouth disease. That fundamental experiment throws quite a new light on the pathogenesis of infectious diseases. At least it shows our previous errors in attributing to a visible germ a pathogenic value which did not really belong to it. The writer has never encountered a natural immunity, though birds cured of the disease have acquired a real and lasting immunity.

The immunity as in other *neurotropic ectodermoses* proceeds by stages. Sometimes the inunune organism behaves as a germ carrier.

The neuro-vaccine may grow in the testicle, the ovary and more raraly the lungs at a time when the skin and the brain have already acquired a refractory condition. The immunity conferred by the disease lasted in the experiments for at least a year. The writer has searched for the presence of anti-bodies in the blood of fowls vaccinated or cured of the natural disease. It was impossible to prove the presence of anti-bodies. VERGE took for virus intended for the preparation of vaccine the variolic nodules and combs taken from young cocks experimentally infected by virulent inoculation in the axillary vein and virulent smearing of both sides of the comb previously scarified.

The tumours are pounded and the emulsion is filtered and the filtrate is added to a phenic solution. The vaccine is injected intra-dermically or under the skin of the wing.

Immunity begins towards the 17th day following vaccination, it is firmly established from the third week and lasts at least ten months.

During the season 1924-1925, 50,000 doses of vaccine were delivered.

The treatment of sick birds requires repeated vaccinal inoculations: the fowls getting the vaccine every 4 or 5 days until cured.

The vaccine acts therefore not only preventively but also curatively. It constitutes an excellent method of treatment and enables a number of birds to be saved which could not otherwise be cured.

Codliver Oil Feeding.

VON VERSEN. *Deutsche Landwirtschaftl. Geflügelzeitung*, No. 42, 1925.

Four weeks before the moult was due, codliver oil was given in capsule form. The plumage was very quickly shed, the health was very good during moulting, laying capacity was not interrupted, the new growth of feathers took place very quickly. The winter production of eggs increased. During the rearing season in the spring however moulting again took place, as the doses of codliver oil were not given. After the introduction of codliver oil feeding, moulting ceased immediately, and laying capacity began again, Fully grown animals receive at most 1 g. per day; more causes disturbances in the organism, encourages moulting in spring, and has disadvantageous effect on breeding results. 1 g. acts very favourably on leg production, breeding, growth and health of the chickens, power of resistance and proof against the weather. It is best to give chickens 14 days old 1 g. for 20 animals, after 5 weeks 1 g. for 15 animals, and so on. Appearance, especially in the matter of glossy feathers, is much improved by codliver oil feeding. Emulsion is not recommended on account of harmful admixtures.

The Sussex.

CLEM WATSON. *The Feathered World*. London, 1926.

An excellent brochure on the Sussex by Mr. CLEM WATSON who is secretary of the Sussex club. The book deals with the subject from the present-day breeder's point of view and the varieties are taken systematically, dealing with Light, Red, Speckled, Brown and Buff Sussex. It contains a detailed description of the standard, illustrated with some plates of feathers and numerous photographs. It gives much general information on mating for the benefit of the beginner and is a standard work upon the breed.

Investigations Regarding Form of Body and Laying Perfomance.

WEINMILLER, Dissertation, Technische Hochschule. München, 1924.

287 animals of various light breeds were measured, and 12 indices drawn up, and these brought into relation with the laying performance. The results were as follows:

A. With light breeds.

1. Animals with relatively deep and wide breast, and animals, which in comparison with their total size possess long carcases, represent the best layers.

2. Animals with comparatively long breast-bone ridge, and great distance of the end of the breast-bone ridge from the os pubis, are good layers.

3. Great distance of the end of the breast-bone ridge from the os pubis, considered by itelf, is no sign of good laying performance.

4. The distance of the two ends of the os pubis from one another should amount to about a third of the width of the carcase of the animal. Animals with a smaller distance are bad layers; the exceeding of this smallest measurement has no connection with an increase of output.

5. The length of the lower part of the leg and ankle has no relation to the output.

B. With heavy breeds correlation between the measurements of the skeleton and the laying performance cannot be recognized.

Communications.

Poultry World Congress. International item for the Press. — Doctor ALWIN PAPPENHEIMER pathologist of the College of Physicians and Surgeons of the Columbia University, known internationally as one of the greatest authorities on paralysis of man and animals, has promised to present a memoir at the World Poultry Congress which will be held at Ottawa from the 27 July to the 4th August 1927. Among other eminent men of science who will present memoirs are Doctor E. E. TYSSER of the Division of comparative Pathology, Harvard Medical School, an authority on diseases relating to protozoa. Doctor D. F. KAUPP of the College of the State of North Carolina, the pioneer of avicultural pathology in America; Doctor B. J. C. te HENNEPE Jzn. of the State Serum Laboratories at Rotterdam, Holland, a famous European authority on poultry diseases; Doctor CREW of the University of Edinburgh, an authority on breeding. The Board of Agriculture for Scotland has announced that three official delegates will be chosen to be present at the coming Congress. Mrs MACIVER a member of the Board will present a work on " Poultry breeding for women " Mrs MACIVER is a great poultry enthusiast and will be eminently competent to deal with this important question.

The Spanish Government has accepted the Canadian Government's invitation to take part in the Congress and an imposing national Committee has been appointed. At the head of the Committee is Excmo. Sr. Professor Don SALVADOR CASTELLO, founder and Director of the Royal School of Aviculture of Spain, who was President of the Executive Committee at the second World Poultry Congress held at Barcelona in 1924. His colleagues will be Don IGNACIO VICTOR CLARIO Y SOULAN, Director of the School of Agricultural Engineering

MARQUES DE CASA PACHECO, President of the Poultry section of the General Society of Animal Husbandry of Spain; Don ZACARIAS SALAZAR, Professor of Zootomy and animal Pathology at the special School of Agricultural Engineering, Don ENRIQUE PERES VILLAMIL, Secretary of the Exhibition of the World Poultry Congress at Barcelona in 1924; Don PEDRO LABORDE BOIS, Secretary of the World Poultry Congress at Barcelona.

The Consul General of Finland in Canada, M. A. RANANHEIMO, will represent the Government of his country at the Congress. In acknowledging receipt of the invitation to take part in the Congress the Government of Finland made allusion to the great importance of the Congress for demonstrating the various phases of world development of poultry keeping.

In accordance with the wishes of the Government the Central Committee of Aviculture of Poland is organizing the participation of that country in the World Congress. Dr. STEFAN KOPEC of the Institute of Agricultural Research of the Government of Poland, at Pulawy, and Professor MAURICE TRYBULSKI, of the Warsaw College of Agriculture, are at present preparing memoirs which they will deliver at Ottawa in 1927.

AGRICULTURAL INTELLIGENCE

GENERAL AGRONOMY

Agricultural Meteorology.

601. **Causes of drought in North-Eastern Brazil.**

S. Paio Ferraz, J. De. (Director of the Meteorological Service of Brazil). Causas provaveis das sênas do Nordeste Brasilero. Ministry of Agriculture, Industry and Commerce, Directorate of Meteorology, p. 3-30. Rio de Janeiro, 1925.

Meteorologically, the problem of the strange annual variations of the rainfall in North-Eastern Brazil is of the utmost importance both for students of meteorology in that country and those outside it. The disastrous droughts which alternate in an abnormal manner in the zone between Bahia and Piauhy are known as an effect whose cause however must be attributed to distant zones. For many years the investigation of this anomaly of the North-East has preoccupied students of Brazilian meteorology and for many years also it has been sought to find some satisfactory solution of the problem in normal local data. This stated, the writer describes the mechanism of the formation of rain and, in greater detail, the more common and fundamental process based on the theories of Bjernkenes (father and son), of Solberg and Bergeron, who have shown the behaviour of low strata of the air (in cases of local depressions and disturbances) due to their super-saturation. According to the unanimous opinions of meteorologists the direct cause of rain is adiabatic cooling. The writer explains the three cases (fig. 1, 2, 3) which occur most frequently, the first of which is common throughout Brazil. In the first case, the moist currents are obliged to rise when they meet with a mountain, being cooled by expansion and therefore lightening themselves of aqueous vapour which they can no longer hold. The second case takes place by the rising of a warm moist current in consequence of the arrival from below of a cold current. In Brazil this occurs on occasions of irruptions of anticyclones, when cold winds disturb the super-saturated surrounding atmosphere of the depressions. The third case relates to a warm moist current overlying cold air. In Brazil this is found in the region of the extreme south, in special conditions of vertical movements, connected with systems of low pressure

After some consideration of the previously mentioned cases, the writer examines the pluviometric map of Brazil (fig. 4), observing first of all that, generally speaking, its distribution has the usual characters. The greater rainfall coincides, as is seen, with elevations or with the zone subject to the equatorial pluviometrical regime, while the low coastal zone with heavy rainfall of the whole Atlantic littoral of Brazil is notable. The factors of some regions are then investigated, the writer insisting specially on BJERKENENS and SOLBERGERG's theories regarding rainfall due to convection currents. Now, what the two Norwegian meteorologists adopt to explain the local rains (" dev veras ") in Norway, due to phenomena of vertical convection, the writer considers to be the great and principal factor of the rainfall of North-East Brazil, manifesting, however, its own influence in other regions also. The writer then maintains that the dryness of the North-Eastern region depends on the vertical gradient of temperature of the atmospheric mass of those regions, affirming that modifications of that gradient are connected with modifications in the cold higher air. The demonstration, supported mainly by aërial soundings of the aerological stations of Cuyabà and Franca, tends to connect the problem of the rainfall of the North-East with the trajectories of anticyclones , by which, these being absent or pàssing much further south, there would be a notable scarcity of rainfall.

Various questions arise relative to the *causa causarum* that is to say to the reasons of such modifications in the atmospheric circulation, across the South-American continent, but it is not possible to satisfy the many questions which arise on this point, as they are connected with and dependent on problems of world wide meteorology. To solve in a satisfactory manner the problem of drought in North-Eastern Brazil, it would be necessary to discover the reason of the absence or deviation of the anticyclones ; this being done, it will be very easy to foresee the dry periods. And the writer, who energetically and most competently directs the Brazilian Meteorological Service, is confident of obtaining this result, when, the national system extended and the indispensable correlations between the observations of the whole world (desired and already requested in various meteorological conferences) obtained, it will be possible to deduce in rapid synthesis the mechanism of the atmospheric circulation of the whole globe and follow its progress and variations, deducing the factors which can be applied to all branches of civil activity. A. F.

602. Solar Radiation Recorders.

HAMES W. B. (Soil Physics Department, Rothamsted Experimental Station). *Quarterly Journal of the Royal Meteorological Society*, Vol. 51, No. 214, pp. 95-100, 2 fig. London, 1925.

The author gives a brief outline of the results obtained by a comparison of the radiation records at Rothamsted. The different apparatus in use in most stations do not give comparable results, which constitutes a serious obstacle to the systematic study of radiation, the key-stone of

meteorological science and of its practical applications. Hence, the comparative study undertaken at Rothamsted forms a valuable contribution. WILSON's radio-integrator and CAMPBELL-STOKE's Helio-phanograph have been used for many years but only since 1921 has it been possible to establish averages and to discuss data. In 1921 the Physiological Plant Institute of the Imperial College established a Callendar and the results given by this apparatus were considered the base for comparison with others. CAMPBELL-STOKE's helio-phanograph is too well known to need description. WILSON's radio-integrator is formed by two connected bulbs of empty glass, one of which contains coloured alcohol and remains in the sun; the other lower one is however protected on all sides. The sun's rays falling on the first bulb cause distillation of the liquid into the lower tube which is properly graduated. The volume of the liquid thus obtained gives the total measure of the radiation encountered. The Callendar apparatus has a receiver formed by two platinum resistances contained in a glass tube. They are rolled up over a horizontal strip of mica and one of the resistances is blackened. The whole thing acts as the resistance thermometers; the changes of temperature being determined by the quantity of radiation received. The first resistance absorbs the whole radiation while the other reflects it entirely.

A continual registration is obtained by connecting these resistances by a Wheatstone bridge to a self-registering duly standardised system. In the diagram (fig. 123) the data yielded by the 3 apparatus since 1 April 1922 are given for each week. The daily data were always from sunrise to sunset. The study made on the Callendar being the only one absolutely self-contained, it became necessary to use certain conventions for reading the other instruments. A factor was therefore given for use in reading each apparatus so as to obtain from them all the same value during a given period of intense radiation (clear summer weather). As may be seen by the diagram, WILSON's radio-integrator gives much higher results during the summer than at any other time and much lower results during the winter. The hours of sunshine taken as a base of the whole radiation give on the contrary far higher results during winter months, owing to the fact that an hour's sunshine is given the same value irrespective of the time of day or year. Dr. ÅNGSTRÖM has always used a very simple formula for calculating the effective whole radiation in view of the hours of sunshine namely: $Qs = Qo\ (.25 + .75\ S)$.

S shows the relation between the present power of sunshine hours and its possible maximum for a fixed period of the year.

Qo shows the maximum of the radiation for a clear day and

Qs the required value of the whole radiation.

ÅNGSTRÖM judged this formula very suitable when the data were taken (at Stockholm) for a period of at least one month. Without any change it was applied to the data taken at Rothamsted and the following table shows its precisions. The numbers express the difference in percentage between Qs as it was noted with the Callendar and Qs as it was noted with the above mentioned formula. The table gives the results of

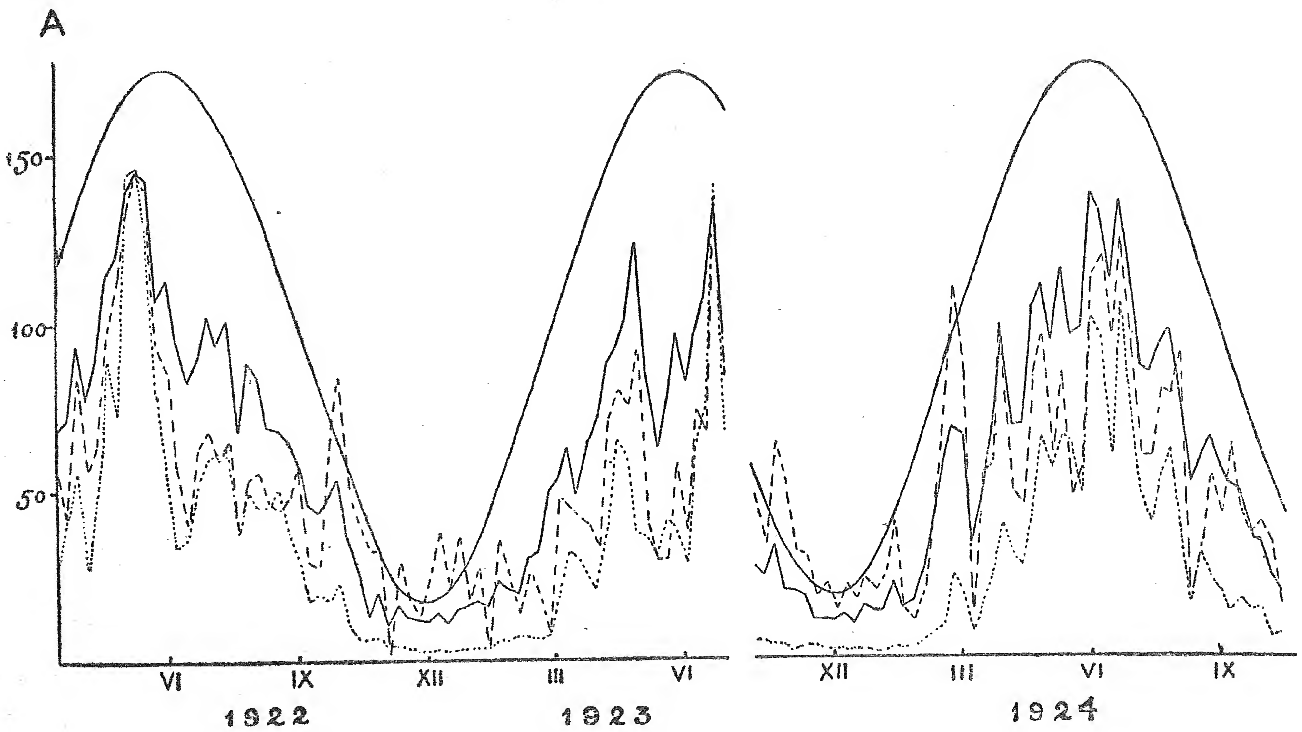

FIG. 123. — Radiation Records at Rothamsted.
——— = Callendar Recorder.
– – – – = Hours of Sunshine
. . . . . . = Wilson Radio-integrator.
A = × 100 Joules per cm² (per week).

a whole year with some extra values taken from some months of other years.

January = 17.
February = 15.
March = 18.
April + 4 — 13 + 9.
May = 11 — 11 — 5.
June + 5 — 12 — 5.
July — 9.
August — 15.
September — 8.
October — 1.
November O + 22.
December — 9 + 22.

The total variation agrees with that found by ÅNGSTRÖM. An examination of the above table shows that the general tendency of ÅNGSTRÖM's formula is to give too small values to the Rothamsted figures.

WILSON's radio-integrator is held to act with an equilibrium approximating to that of surrounding objects. When a quantity of heat $d\,Q$ is received by the higher bulb in a $d\,t$ and $T\,1$ and $T\,0$ time the temperature of the bulb and of the surrounding objects is respectively :

$$d\,Q = l\,d\,w + A\,(T1^4 - T0^4)\;d\,t$$

in which the first term gives the quantity of calories used for evaporating a weight dw of liquid and the second term the quantity lost by irradiation. Given that the volume of the distilled liquid has to be a direct measure of the radiation received the second term might be neglected. But this cannot be a likely case because the difference of temperature (and therefore ot the steam pressure) between both bulbs is a necessary condition for the distillation of the liquid from the first into the second bulb.

The lower bulb may be considered to have the same temperature as the surrounding objects. For the purpose of experiment, three days of the same month were chosen for obtaining a low, an average and a high radiation value.

Calculations were made from th: Callendar data and the dimensions of WILSON's bulb on the volume of alcohol that ought to have evaporated daily if there had been no losses. The values obtained were respectively 16 = 8 and 3 times the volume collected in WILSON's radio-integrator.

We can therefore conclude that the loss by irradiation is always considerable but especially so when the quantity submitted to irradiation is smaller.

This seems at first nonsensical because the difference in the steam pressure that causes the distillation of the liquid ought not to follow so quickly on the increase in the change of temperature as the loss due to irradiation. But we must not forget that at high radiation values the objects surrounding the bulb remain warm while the bulb itself is cooled by the evaporation in it which is always noticeably inferior to the loss by

irradiation. The dissipation of the heat in the alcohol contained in the lower bulb becomes on that account a very important factor.

A correlation diagram shows that WILSON's radio-integrator can give quite valuable measurements in comparison with those obtained with Callendar's apparatus. The curve traced is a parabola having the following equation :

$$C = 1057 \sqrt{w}$$

in which C is given by the Callendar's instrument in joules per cc and W by WILSON's radio-integrator in cc.

On the whole, although new elements may displace the above mentioned data of comparison — especially with average temperatures given for longer periods — and despite the objections raised against its data as being impossible to compare with those given by other instruments of the same sort, WILSON's radio-integratior is obviously in good enough agreement in its data to the Callendar. Considering its great simplicity and the exactitude of the observations obtainable with the correction formula, this is an instrument that deserves to be better known and used especially in the ecological stations where the study of solar radiation becomes day by day more important. A. F.

603. **Transmission of meteorological-agricultural data by means of radiotelephony**

SANSON, J. Téléphonie sans fil et prévisions agricoles. *La Vie Agricole et Rurale*, Vol. XXVI, No. 13, p. 209-211. Paris, 1925.

Radiotelephony apart from its other uses has become a powerful means of rapid diffusion for meteorological news which may be useful to agriculture. It is already three years since the Ministry of Agriculture in France, in view of the progress made both in the field of meteorology and that of radiotelephony, recognized that it ought to be utilized in the field of practical agriculture. Consequently, in a circular to the Prefects, the Ministry itself intimated that consequent on news coming in from all parts of Europe four times a day to the Central Bureau of Meteorology, the latter was in a position to send out probable forecasts valid for the following 18-24 hours. Four times daily the Eiffel tower, at stated hours, sends out a message which can be picked up within a radius of 500 km. by all stations provided with a galena receiver. Having received the message, the telephone station, to diffuse the details, makes use of a bell adopting conventional signals. Three strokes indicate rain, six frost, ten a storm, a hurricane or hail. The absence of signals indicates that no change of weather is expected. One of the most effective provisions for the practical diffusion of this method, the multiplication of radiotelephonic receiving apparatus, has been the suppression of the fiscal tax so that a farmer now, with the greatest ease and a minimum of expense, is in a position to prearrange work and all other cultural practices on the basis of weather reports which are transmitted to him. It is needless to stress the economic advantage. Moreover, the installation and utilisation of a radiotelephonic

station does not require any special knowledge and is very easy to set up. It consists of three parts :— (*a*) An antenna ; (*b*) a receiving apparatus (detector and electric listener) ; (*c*) an earthing arrangement. The article indicates the processes generally used for the construction of a despatching installation, enlarging especially on two types of antennae internal and external, the latter commoner than the former ; it also indicates the parts of the receiving apparatus :— detector with crystals and valves with three electrodes. Finally it gives a brief explanation on earthing. A. F.

604. **Botanical Analysis of Cultivated Pastures.**

ELLINGBØ M. *Meldinger fra Norges Landbrukshøiskole*, Nos. 2-3, pp. 113-145, tables 4, bibliography. Oslo, 1925.

The importance is evident of judging the value of a pasture from a nutrition point of view, the obtaining of information as to the quality of the herbage, and for deciding upon the best cultivation treatment of a grazing land.

Such investigations are carried out by means of a botanical analysis, and many methods have been tried, the most successful of which is that of Prof. LENDE-NJAA, devised in 1923, which estimates the percentage of the different plants of the crop.

The great advantage of the method is that it is quick and sufficiently exact, and that it controls and trains the estimating ability of the investigator.

Plots are selected, each 0.5 sq. m., the number being in relation to the size of the field. Botanical analyses should be made at least once a month.

The exactness of the method depends upon the estimating ability of the investigator, the number of plots in relation to the area, and the suitable distribution of plots. W. S. G.

Agricultural Botany, Plant physiology and chemistry.

605. **A bioenergetic law in plants.**

TERROINE, E. F., TRAUTMANN, S. and BONNET, R. Loi bioénergique de la formation des hydrates de carbon aux dépens des protéiques et des graisses chez les végétaux. *C. R. de l'Académie des sciences* v. 180, No. 15, p. 1181-1183. Paris, 1925.

During germination in the dark and in distilled water, a process which consists almost solely in the formation of cellulose at the expense of the reserve of the seed, the gross energy yield varies in proportion to the reserve, being high (72 %) in seeds rich in starchy matter (rice), weaker (65 %) in those with smaller quantities of starch and larger quantities of proteins (lentils), and decreasing to 53 % in seeds composed of a mixture of proteins and fats (ground nuts).

On the basis of these facts, the conclusion is arrived at that, in the seeds investigated, the formation of hydro-carbons entails a considerable

loss of energy if it takes place at the expense of proteins, and that it is still large, but less so if it takes place partly at the expense of the fats. Extending the researches to other seeds, it was seen that there is a general law and that the values obtained by calculation are fairly close to those obtained experimentally. By which the following law may be formulated that, *in plants the transformation of proteins into hydro-carbons is accompanied by a loss of 35 % of the metabolized energy and that of fats by a loss of 23 %.* A. F.

606. **Contribution to the knowledge of the influence of acidity on the growth of plants.**

NEMEC, A. and DUCHON. Prispevek k otazce vlivu acidity na vzeust restlin. *Zpravy vijzk, ustavu zemedelskych* no. 8, Ministry of Agriculture. Prague, 1925.

Waterculture experiments made on maize and blue lupin for the study of the influence of the nutritive medium's reaction on the plant lead us to the following conclusions: the development of plants, cultivated in the artificial medium of nutritive solutions, depends on the reaction of the liquid, and this is an important factor in growth.

As the concentration of the hydrogen ions ascends, plants seem to show a tendency to accumulate the mineral products in their leaves and roots. The optimum reaction of the nutritive surroundings for the growth of plants is ruled by the stage of development of the plant in question, in which the hydrogen ions in the solution play their part.

If the acidity of the liquid surroundings starts its influence at the beginning of the germination of the seed, the optimum return corresponds to a feebly acid reaction of pH = 6.0. Maize plants first raised in normally nutritive surroundings and later on, in an advanced state of development, put into liquids of varying degrees of acidity, show a maximum growth at a higher acidity of pH = 5.1. Finally by letting the nutritive solutions of different degrees of acidity act upon the plants when fully developed the most favourable growth is shown at a reaction of considerable acidity pH = 4.0. Moreover we find that the acidity tallying with optimum growth for a lupin grown all the time in the same solution is less — pH = 6 — than that for one introduced at a later stage of development — pH = 5. Whereby we see that the germinating grain is much more sensitive to the acidity of its medium than more advanced plants.

With the progressive development of the maize plant, the optimum growth reaction tends towards a higher concentration of H ions, so that the optimum acidity index of grown plants corresponds to a fairly high H ion concentration. The reaction of the nutritive medium undergoes important changes during plant growth. It is interesting to note that these changes tend to force towards or even to stabilize the reaction of the nutritive solution at a certain fixed concentration of hydrogen ions. However these changes in reaction only take place as long as the degree of the acidity of the liquid exercises a toxic influence on the organism of the plant.

In short our experiences teach us that the living plant possesses a

certain power for regulating the reaction of the medium in which it grows, which is able to change an unfavourable concentration of hydrogen ions into one more favourable for the growth of the given variety.

607. **The Relation of Root Growth to Oxygen Supply in the Soil.**

CANNON, W. A. *Ecology*, Vol. V, No. 4, pp. 319-321. Brooklyn, 1924.

The writer in making water extracts of soil, considers two factors of special importance (in all surroundings and for all species of plants) namely, the temperature of the soil and the quantity of oxygen supplied to the roots.

As is known, a variation of temperature, the other factors remaining equal, causes an immediate variation in the amount of growth of the roots.

Similarly it may be said that variation in the partial pressure of the oxygen in the soil air (being low) produces similar results.

In his note, the author aims at defining two points in the temperature-oxygen relation of the roots namely: — how an increase and decrease of temperature can modify the amount of growth of the roots themselves, in the presence of a low partial pressure of oxygen; secondly, the actual correlation between the quantity of oxygen required to produce certain amounts of root growth and the capacity of absorbing oxygen by soil water at a given temperature. Deficient oxygen is a limiting factor of root growth at any temperature and in a ratio which is characteristic both for temperature and species. For this reason from this point of view, an expression which would define the amount of growth in relation to temperature and oxygen supply would be very desirable. For this purpose the ratio of growth and the relative growth connected with the two factors may conveniently be used. This may be defined as the amount of growth observed at a given temperature and in respect of a given partial pressure of oxygen (r) divided by a certain amount of growth at the same temperature but in normal conditions of aeration (R) namely $\frac{r}{R}$

It has been found that, at least up to a certain degree, the relation of growth may be characteristic for a given species. That defined, such relation seems to have at least two notable characteristics. In certain constant conditions of low pressure of oxygen, its value varies inversely with the temperature, while at constant temperature, its value varies directly with the partial pressure of the oxygen because the latter is small. In the few instances which follow from the first of these characteristics, it may be noted that only the temperature varies, further note that in all the experiments in which the oxygen is shown in percentage, it is understood that the mixed gas is nitrogen and that the reference is to volume.

With *Allium Cepa* using 1.6 % of oxygen the ratio of growth varies between 0.6 and 0.9 at 16° of temperature (C.) and from 0.8 to 0.25 at 21°.

Citrus medica with 2.8 % of oxygen has a ratio of about 1 at 23° and about 0.6 at 27°.

With *Zea Mais*, with 3 % of oxygen the ratio is about 0.35 at 17°

and about 0.06 at 30 degrees. It was however observed with these three species that the root growth decreased as the temperature increased. It is also clear that specific differences exist, as is shown by the reactions, between the quantity of oxygen in relation to the temperature.

Similar reactions were obtained with *Opuntia versicola*, *Pisum sativum*, *Gossypium hirsutum* and *Potentilla anserina* and may consequently be accepted as representing the usual relations of the root system. Returning to the consideration of variations in growth consequent on changes in oxygen, the temperature being constant, the author mentions the following results.

At 20° with *Prosopis velutina*, the ratio of growth is 0.14 with 0.06 % of oxygen, 0.33 with 0.8 % of oxygen, and 0.71 with 2.2 % of oxygen. *Zea Mais* at 17° gave 0.66 with 3.6 % of oxygen and 0.98 with 1 % of oxygen.

For *Citrus sinensis*, at 27° the ratio is 0.6 with 0.8 % of oxygen and 1 or normal with 1.2 % of oxygen. Similar results were observed in other experiments, from which it appears that the condition reported is general. Two points may be noted — firstly, diverse relations were established in roots with an equal supply of oxygen, when, however, the latter was in very small quantity, in which case as was observed previously, there may be specific relations. Secondly what constitutes a *small* supply of oxygen is purely a relative matter.

Again, such *small* quantities of oxygen may easily coincide with such quantity as the water is capable of holding in solution at various temperatures, varying from 15° to 30° C. A. FÀ.

608. **The dispersion of the endosperms of maize.**

BESSENICH, Fr. Untersuchungen über die Endospermenentleerung von *Zea mais*. *Jahrbücher f. wissenschaftliche Botanik*, v. 83, No. 2, p. 231-272, 7 fig., 16 tab., bibl. Leipzig, 1925.

DAHM, P. Untersuchungen über die Abhängigkeit der Endospermenentleerung bei *Zea mais* von verschiedenen Salzen. *Ibidem*, p. 273-320, 2 fig., 17 tab.

It appears from BESSENICH's researches that the dispersion of the endosperm of *Zea mais* is prevented by sulphate of calcium and is retarded by the H. ions of various acids. Every acid has then a specific action determined by the anions; thus hydrochloric acid has a greater preventive action than that of phosphoric acid at the same pH concentration. The most favourable conditions for dispersion are given by pH = about 5.

The OH ions also have preventive action which is reduced as the neutral point is approached. DAHN has renewed BESSENICH's experiments, improving the technique, in such a manner that 80 % of all the investigations remained unaffected by bacteria. The quantity of sugar evacuated (which in many experiments attained 80 % of the maximum quantity possible of the starch content) is subject to considerable variations even between the grains of various plants of the same race. The experiments are only comparable between the grains of the same plant and are made at the same temperature and with the same duration. Solu-

tions of the chlorides of the alkalies and of the alkaline-earths, in determined concentrations, prevent the emptying of the endosperm. They are here put in order of capacity for so doing: Na, NH_4, Mg, Ca, Sr, K, Ba, Li. Sodium salts in order of capacity for such action are as follows: — sulphate, nitrate, chloride, primary phosphate, rhodonate, tartrate, bromide, borate, carbonate, secondary phosphate, acetate. It still remains however to be proved whether it is a case of simple action of ions.

The endosperm of maize, in a dry state, does not contain any active diastase; for hydrolysis of the starch the aleurone stratum is necessary, which is probably tissue formed by diastase. This function cannot possible be exercised by the *scutellum*.

The reduction of the starch in the endosperm of maize is not a true enzymic process, but the vital activity of the cell is necessary for it. The diastase is diffused in the dispersion fluid. When the latter is caused to act on soluble starch it is seen that certain salts (chloride of barium and of lithium), with 0.1 *molarous* concentration, help the hydrolysis of the starch, preventing however the emptying of the endosperm at the same concentrations. On the other hand, for example, chloride of calcium at the same concentration greatly hinders the reduction of the starch, while it acts rather less than the other salts on the dispersion process.

Inasmuch as the processes indicated should be understood as attached to the vital activity of the cell, it may be considered that the preventive action of the salts is effected either by suspension of vital activity or else by its influence on the permeability of the plasma. F. A.

609. **The Growth of the Cotton Plant in India.**

INAMDAR R. S. SINGH S. B. and PANDE T. D. (Benares Hindu University). *Annals of Botany*, Vol. XXXIX, No. CLIV, pp. 281-311, fig. 8, bibliography. London, 1925.

The Authors carried out research on the relative growth-rates during successive periods of growth, and the relation between growth-rate and respiratory index, throughout the life-cycle of the cotton plant.

An investigation of the quantitative analysis of growth in *Helianthus* was carried out by KIDD, WEST and BRIGGS, and it was decided to apply their methods of work to tropical plants in order to evaluate quantitatively the internal and external factors concerned in growth.

The experiments were designed to compare :—

(*a*) The relative growth-rate curves of plants grown in different periods of the year.

(*b*) The relative growth-rates with variations in leaf-weight ratio and the leaf-area ratio.

(*c*) The relative growth-rates on the one hand, and variations in the respiratory indices of the entire plant and of its parts throughout the life-cycle on the other.

Selected seed of the variety *roseum* of cotton were used in all the experiments.

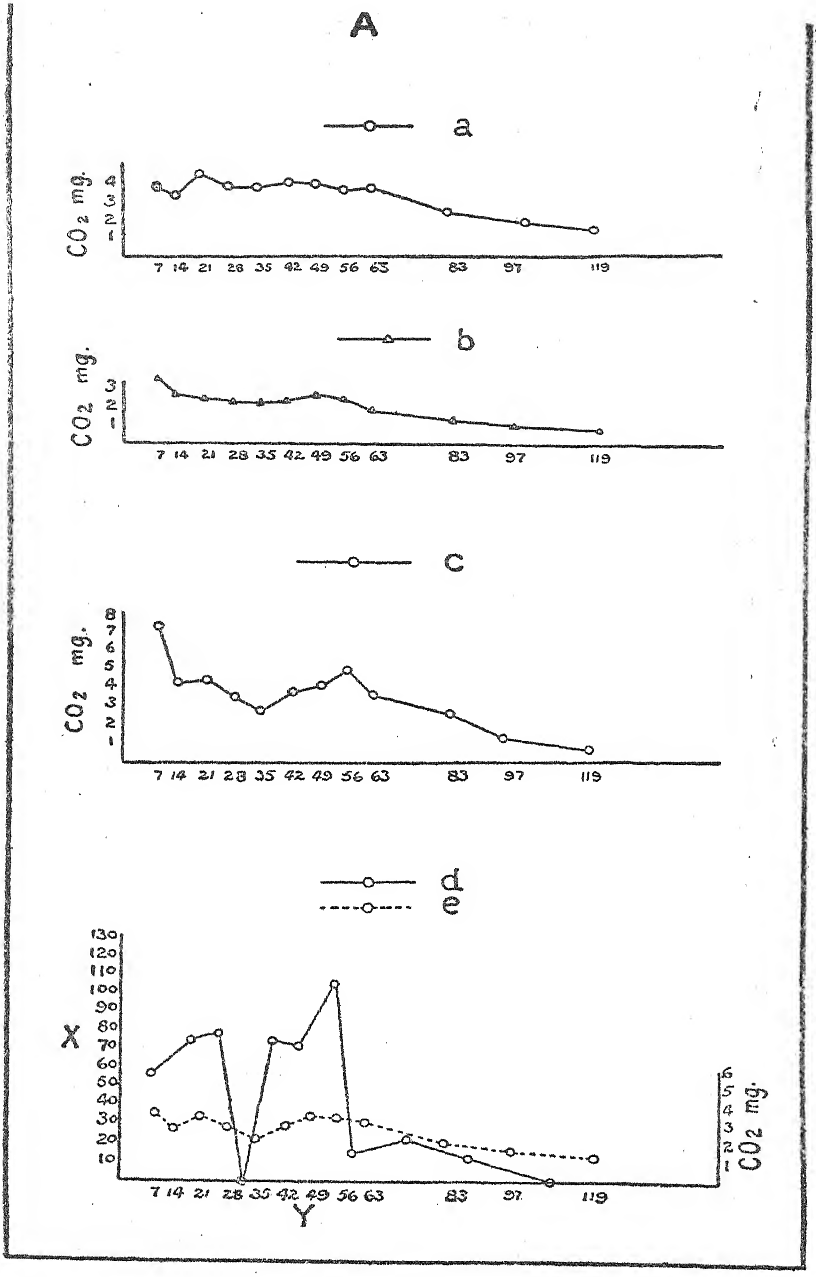

FIG. 124. — *Growth of Cotton Plant in India.*

a = Respiratory indices of leaves.
b = » » straw.
c = » » root.
d = Growth rate.
e = Respiratory indices of whole plant.
X = Weekly relative growth in percentage.

Respiration was measured in the laboratory at a temperature of 38° C. Separate estimations were made for roots stems and leaves.

The growth of cotton plants was measured by the dry-weight method, and the relative growth-rate per week calculated on an exponential basis

A summary of the authors' work is as follows:

(1) The growth-rate curves show a maximum increase which is reached sooner or later according to the duration of the vegetative period. The shorter the vegetative period, the earlier is the maximum reached.

(2) The growth-rate curves are compared with variations in the leaf-weight ratio and leaf-area ratio. The growth-rate curve is divided into three phases in this connexion:

(*a*) An initial phase when the curve agrees neither with the leaf-weight ratio nor the leaf-area ratio. This may be due to the leaves not yet having attained their maximum assimilating capacity.

(*b*) An active phase of growth when the relative growth-rate curve runs parallel to the curve of either the leaf-weight ratio or the leaf-area ratio. In plants grown in bright weather in the summer, the growth-rate is influenced by the percentage-weight of the leaves, while in cloudy weather the area exposed appears to be the determining factor.

(*c*) In the last phase of growth there is greater decrease in the growth-rate than can be accounted for by the decrease either in the percentage leaf-weight ratio or the leaf-area ratio. This may be due to reduced assimilating capacity of the leaves.

(3) The growth-rate curve is compared with the course of the respiratory index of the plant throughout the period of growth. The course of the respiratory index is found to run parallel to the growth-rate curve, a conclusion which can be extended to the results of KIDD, WEST and BRIGGS on *Helianthus*. The results on the respiratory values of the meristematic tissues differ, however, from those obtained by the three authors. It is concluded that the course of the respiratory index merely expresses the intensity of the series of "protoplasmic activities" which influence growth-rate. It does not seem to have any influence on the decreasing or the increasing of growth. W. S. G.

610. **Studies in Transpiration of Seedlings of Conifers.** *

PEARSON, G. A. *Ecology*, Vol. V, No. 4, pp. 340-347, fig. 2. Brooklyn, 1924.

In 1919-20, transpiration measurements were made at the South West Experimental Station (Los Angeles) on seedlings of four conifers, natives of the mountain of Arizona and New Mexico. The species selected were the western yellow pine (*Pinus scopulorum*), *Pseudotsuga taxifolia, Pinus aristata* and *Picea Engelmanni*.

The habitat zone of the yellow pine is at an elevation of 2000-2500 metres where the average annual rainfall amounts to 22 inches and that of the maximum temperature to 75°F.

The seedlings in question, varying in age from 2 to 5 years, were

*See: BATES Charles C. Physiological requirements of Rocky Mountain trees. *Jour. Agric. Res.*, Vol. 24, No. 2, pp. 97-164, 1924.

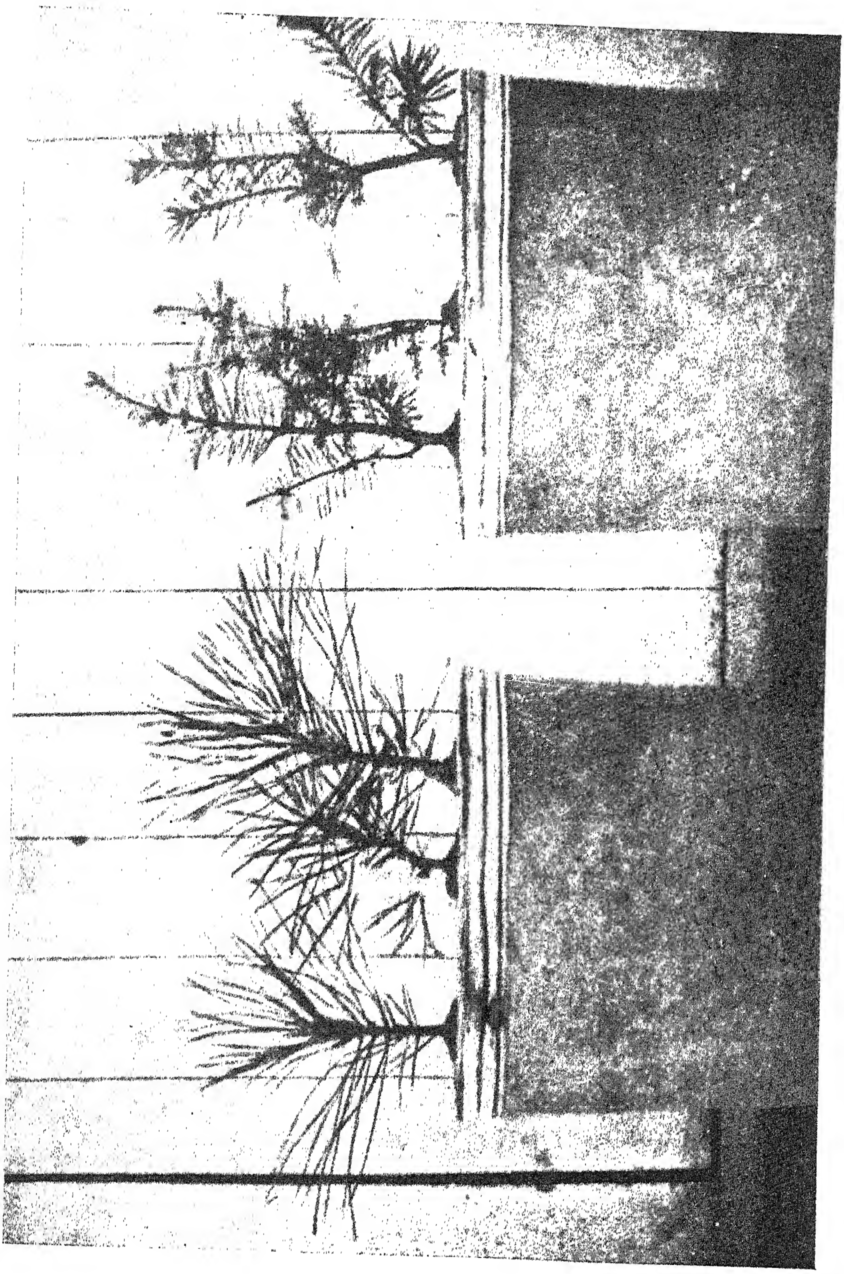

FIG. 125. — *Pinus scopulorum* and *Pseudotsuga taxifolia* in pots prepared for measuring evaporation.

planted in galvanised iron vessels, about 25 cm. high and having an upper diameter of 23 cm. Preliminary experiments had shown that the method of coating pots with sealing wax was unsatisfactory and therefore metal vessels were used.

In the paper cover wrapping at the base of each plant (fig. 25), a one inch hole was made and these holes were closed later by a covering which left a small space round the stem of the plant; these spaces were then closed with clay. Air and water were introduced through a glass tube, the lower extremity of which ended in a cylindrical porous receptacle (LIVINGSTON), perforated at the sides and inserted in the soil. A small glass cap over the free end of the tube served to keep out rain while allowing air to enter. The soil was taken from the surface in a *Pinus scopulorum* forest at the base of the trees themselves. It was sifted through a 3 mm. sieve, of such a mesh as to exclude only the larger material. Preliminary experiments made in the soil of the immediate vicinity had proved the wilting coefficient to be 10.5 %.

After the seedlings were planted in the vessels, water was added to bring the total humidity contained in the soil to 20 %. The gross weight of each vessel with humidity of 20 % was then calculated, and after each weighing, during the period of the experiment, the weight was always brought up to its initial amount. Judging from the growth and excellent development of the root system of all the species, except *Pinus aristata*, it may be deduced that the vessels furnished absolutely suitable conditions of soil.

The interval between the various weighings was varied according to the season; during the spring period the weighings were ordinarily made every 3 or 4 days, but during late autumn or winter the interval was prolonged to a month or more. From about the middle of June to the middle of October, according to the weather, the vessels were taken out of the room in which they were sheltered and exposed to full daylight. They were protected from excessive sunshine by small meshed wire netting. Between the 1st January and the 1st April the plants were kept in a cold, slightly illuminated room.

During the progress of the experiment numerous problems arose which it was desirable to solve completely.

Although transpiration of conifers has been studied by various workers, they have, except in few cases, studied the subject from points of view different from those here presented. The most important of the problems to be solved was to obtain a satisfactory series of data which would enable a comparison to be made of the behaviour of various species. The usual method of considering transpiration on the basis of the leaf surface has been abandoned because it cannot express the desired relation. From a forestry point of view, the various species should be compared by taking into account the quantity of water consumed by trees of equal size and volume.

The tree which transpires less per unit of leaf surface is not necessarily that which consumes less water, since this apparent economy may be more than balanced by a larger leaf surface in proportion to the volume

of the tree itself. The first thought was therefore to obtain a satisfactory basis, estimating the transpiration per *unit of weight*, for each plant.

Seedlings of approximately equal size, will produce closely comparable data both in green weight and dry, but varying the size, age and form of the plants, even of a given species, will, on the contrary, cause confusion in the results. From that it is deduced that there is not a direct relation between the amount of transpiration and the entire mass of the seedling; however, it is evident that some relation ought also to exist. It might be supposed that the transpiration was in some way proportional to the mass of active tissue, but a tree contains also more or less inert wood. As the seedling becomes older the, proportion of live tissue in the entire mass decreases ; it is generally less than 5 %.

A better basis of transpiration is found in the growth.

The increase in dry weight is a direct measure of activity and it furnishes also the proportion of the amount of active tissue existing at any time in the tree. Another problem arises from the fact that some species grow naturally under different conditions and presumably under such different conditions have different requirement to realize optimum development ; on the other hand in order to compare their activity they should all be grown side by side in the same medium. In the experiment here described, all the species were grown in the climate and soil suited to *Pinus scopulorum* and only the species *Picea Engelmanni* in more favourable conditions of humidity.

The commencement of growth was notably accelerated by keeping the plants in a greenhouse during the spring months.

For practical purposes it might be useful to have at disposal various young plants each of which takes the place by itself of the species under consideration and can be grown in conditions absolutely similar to those existing in nature.

Capacity of resistance to drought. — In the course of these experiments interesting observations were made regarding the behaviour of the seedlings in respect to drastic reduction of humidity in the soil. On 10 August 1920, in a series of vessels which previously were kept at a constant humidity of 20 %, or approximately 9.5 % relatively to the wilting coefficient, discontinuous watering was practised on the soil in question. The amount of transpiration immediately commenced to diminish, at the end of the first month, it was in many cases less than 3 % of the normal. At the same time the humidity of the soil decreased in amounts varying from 2 to 5 tenths of 1 % of the wilting coefficient.

During the last two months, the transpiration was almost imperceptible ; the plants of all species showed signs of feebleness indicated by change of colour or drying up of occasional leaves ; however, there was no appearance of wilting. With the coming of cold and snow in the latter part of October, the vessels were sheltered in a greenhouse, but a change in mean temperature from 32° to 54°F. gave no appreciable indications regarding transpiration.

To ascertain which plants were really living, two vessels of *Pinus scopulorum* were watered on the 13th November renewing the humidity in the

TABLE I. — *Transpiration in relation to increase in dry weight.*

Species	Age when planted in vessel	Dry weight gm. Initial (a)	Dry weight gm. Increase in 2 years	Transpiration 1919 and 1920 gm. (b)	Water used per 1 gm. of increase %
Pinus aristata 1	5	7.56	19.89	8.186	412
» 2	5	5.42	13.78	6.465	468
P. scopulorum 1	3	6.03	30.25	11.219	371
» 2	2	2.55	16.69	6.469	388
» 3	2	2.87	22.83	9.771	428
Pseudotsuga taxifolia 1	4	8.76	29.06	10.895	375
» » 2	4	11.07	27.61	10.672	387
P. Engelmanni 1	4	7.14	16.51	5.478	353
» 2	4	7.83	31.33	11.445	365

N. B. — Of the values given above each represents three plants since each vessel contained three seedlings.

(*a*) Calculated from the proportion between green and dry weights of similar plants.

(*b*) The covers for the determination of the transpiration were applied from the 1st July to the 3rd October 1919 and from the 3 March to the 1st September 1920.

TABLE II. — *Wilting coefficients.*

Species	Marly clay soil (1) No. of vessels	Marly clay soil (1) No. of plants	Marly clay soil (1) Wilting percentage coefficient	Prepared soil 0.50 marly clay, 0.50 sand No of vessels	Prepared soil No. of plants	Prepared soil Wilting percentage coefficient
Pinus aristata	4	10	10.56	2	2	6.35
P. scopulorum	4	8	10.55	5	7	5.80
Pseudotsuga taxifolia	4	10	10.30	4	4	6.26
Pinus engelmanni	1	3	10.25	3	3	6.03

(1) The vessels considered in Table 1 form a part of this series.

former proportion of 20 %, and immediately the amount of transpiration increased and the supply of water being maintained, after a month new shoots appeared. During the early part of the following winter the tips of various plants turned brown, but in most cases the greater part of the plants remained fresh, thus indicating a localisation of the excessive lack of water.

As a rule, the younger shoots suffer most. In some vessels single plants remained fresh for a long time after their companions in the same vessel were dried up. In the course of this experiment it was shown that all

the plants were dead by the 8th April, except one *Pinus aristata*, which lived until the month of June. It is not possible to draw definite conclusions regarding the resistance of the various species to drought, except that *Pinus aristata* seems to resist better than the others.

The most important fact ascertained in the course of these experiments is that all the species used have a surprising degree of resistance to transpiration even when the supply of water is reduced to a dangerous minimum.

Capacity of absorption of water from the soil.

The capacity of the plants to absorb water from the soil depends on their osmotic power and especially on their capacity for extending their roots in search of moisture. In the seedling stage a rapid penetration into the depth of the soil is itself an indispensable condition for survival. Experiments made on the wilting coefficients indicate that in this respect no substantial differences exist between the various species respecting the power of absorption of water in the soil. More exhaustive experiments may show more definite differences, but it is certain that these will never be so great as to give any species an appreciable margin over the others.

The study of which we have described the principal parts, is certainly not sufficiently exhaustive to give answers to all the questions considered. However, it proves, as has already been pointed out, that in these species there is a large margin of resistance to lack of water when the soil becomes very dry. As regards the problem of the humidity of the soil, as is indicated by the wilting coefficients, the data collected do not present such differences as to make it possible to assign, in this respect, any marked supremacy of one species over another. The more important results and the standards more adapted for similar enquiries may meanwhile be summed up as follows:

(*a*) The problem of transpiration in the forest is more exactly expressed in terms of loss of water by humidity than in those of increase in dry weight. To determine such increases all plants used in the experiment should be weighed before they are planted in the vessel and a specimen of each class should be selected to determine the proportion of dry matter to green weight. For certain purposes, it may be useful to express transpiration on the basis of leaf surface.

(*b*) There should not be too many specimens in the experiments. Each species should be represented by at most 10 plants; a margin of 25 % should however be allowed for plants which die or grow abnormally.

(*c*) The metal vessels should be at least 15 cm. in diameter and 25 cm. high. In all cases it is preferable to use a greenhouse.

(*d*) There are various problems regarding the relations between the water and the seedlings. Each one requires separate experiments. In addition to those here described there are the relations to transpiration in winter, resistance to high temperature, to the effect of light, of humidity and wind. Each experiment, as is obvious, is concerned with many stages

of a seedling and it is also desirable that it should be carried out in more than one kind of soil.

(*e*) Much care should be taken in the selection of the plants employed. A general want of consistency in plants of the same species and class may affect the value of all data. A. FA.

611. **The persistance of vitamin A in plants.**

COWARD HOPE, K. (Dep. of Physiology and Biochemistry, Univ. College, London. The Persistance of Vitamin A in Plant Tissues. *The Biochemical Journal* v. XIX, No. 3, p. 500-506, 4 fig., bibl. London, 1925.

Vitamin A is not used in any process of the plant living in darkness. It appears to increase when the leaves lose their green colour and become yellow. It is completely destroyed when the leaves wither and die.

It is not diffused to an appreciable degree in water from the end of a cut plant. A. F.

612. **The chemical constitution of the cortical membrane of the potato.**

RHODES, E. (Department of Botany, University of Leeds). The Chemical Nature of the Membrane of Potato Cork. *The Biochemical Journal*, v. XIX, No. 3, p. 454-463, fig. I, bibl. London, 1925.

The cortical layer originates from metamorphoses of fatty substances and always contains a certain quantity of fats which have not undergone change and which are soluble and give to this layer the property of being coloured.

For the most part the layer consists of a complex of fatty acids, relatively insoluble, which yield to prolonged saponification. The non-saponifiable matter contains a considerable quantity of volatile bodies; traces of glycerine are also found in it.

These facts may be of importance in the formation of the cortical layers. A. F.

613. **Ammonia and trimethylamine as odorous constituents of the cotton plant.**

POWER, F. R. and CHESNUT, V. E. (Phytochemical Laboratory of the Bureau of Chemistry, U. S. Dep. Agr.). The odorous Constituents of the Cotton Plant. Emanation of Ammonia and Trimethylamine from the Living Plant. *The Journal of the American Chemical Society*, v. 47, No. 6, p. 1751-1774. Washington, D. C., 1925.

The object of this long experimental research was to see if it were possible to isolate from the living cotton plant certain odorous constituents which had an attractive effect on the stalk weevil.

From the concentrated sap of the plant, extracted with ether and distilled, a brown-yellow, clear, limpid, essential oil was obtained, of a density of 0.9261 and polarisation 3°.91, with a rather pleasing and

persistent strong odour; containing aldehyde and giving a strong reaction with furfurol.

The concentrated distillate, which represents all the odorous and volatile constituents, contains :—

(1) Methyl alcohol in large quantities and traces of acetone.
(2) Amyl alcohol in small quantities and higher homologues.
(3) Acetaldehyde and a trace of aldehyde with a higher carbon content, probably a new compound.
(4) Very small quantities of vanillin.
(5) A phenol, in minute quantity.
(6) A dicyclic terpene optically inactive.
(7) A very small quantity of one of the paraffins.
(8) A blue oil, which probably contains azulen.
(9) Formic, acetic, caproic acids.
10) Ammonia.
11) Trimethylamine.

The last two substances are found in rather considerable quantities, but ammonia predominates. Both emanate from the living plant. It seems that the trimethylamine possesses a certain power of attraction for the stalk weevil. Experiments, however, are being made to determine if it really can constitute a food for this insect. A. F.

614. **Relations between the successive quantities of phosphoric acid and nitrogen in the leaves of well manured vines.**

LAGATU, H. and MAUME, L. Relation linéaire entre les quantités successives d'acide phosphorique et d'azote contenues dans la feuille de la vigne bien alimentée. *C. R. de l'Académie des sciences*, v. 180, No. 15, p. 1179-1181, fig. 1. Paris, 1925.

The experiments of the writers show that, in well manured plants, the evolution of the physiological relations of the fertilized elements, observed in the leaf, appears to obey certain simple laws. In fact expressing the results of the observations graphically by the method of Cartesian coordinates, a line is obtained which is very nearly straight.

In May only was there a slight relative excess of nitrogen, due to the fact that the nitric part of the manure, combined with nitrogen nitrified by a favourable season, exaggerated the absorption of nitrogen, which might have been injurious to the plant. Between June and September equilibrium was attained and after the grapes were picked the leaves rejuvenated chemically and became green in comparison with those of the unmanured plot.

The reduction of the crop in the other plots went *pari passu* with the deviation from the straight line. The researches may therefore serve to demonstrate in the case of deficient nourishment and scanty yield, the insufficiency or the excess of one of the fertilizing elements in comparison with the other. A. F.

615. **A new substance in essence of lemon.**

ROMEO, G. (Chemical Lab. of the Chamber of Commerce of Messina). Sopra una sostanza presumibilmente nuova dell'essenza di limone. *Annali di chimica applicata*, v. 15, No. 7, p. 305-309. Rome, 1925.

The writer, from some kilogrammes of oil of turpentine essence, has obtained a light crystalline substance, which at sight is different from common stearoptene and which was not identified with any other known substance in essence of lemon. It melts, in the raw state at 57°-58°, is soluble in cold water to the extent of about 1 %, at boiling point 7 %, is very soluble in methyl and ethyl alcohols or, better, in sulphuric ether. Heated to an anhydrous condition, it boils at 260°, but undergoes a partial decomposition. It is dextrorotatory with a specific rotatory power of 39°.26. Its chemical formula would be $C_{10} H_{18}, O_3$; the quantity was too small to enable the constitution formula to be established. A. E.

CROPS IN TEMPERATE AND TROPICAL COUNTRIES

Cereals and forage crops.

616. **Recent researches on wheat in Russia.**

I. — VAVILOV, Prof. N. K. poznaniou miagkikh pchenitz *Triticum vulgare* Vill. Sistematiko-geografitcgeski etud. *Troudy po prikladnoi botanike i selekzii* Izdanie Gosoudarstvennago Instituta Opytnof Agronomii Tom 13^{i} Vypousk 1^{i} stran. 149-257; ris. 1, tabl. 3, Karta 1 (Contribution to the classification of soft wheats. *Triticum vulgare* Vill. *Bulletin of Applied Botany and Selection*, Publication of the Government Institute of Experimental Agronomy. Vol. 13th 1st number, p. 149-257, 1 Fig., 3 tabl. 1 map, summary in English, Petrograd, 1923).

II. — BAROULINA, Mme E. Opyt sistematitche skago izoutchenia rassovago sostava v upredielakh odnoï raznovidnosti miagkoi pchenitzy (*Triticum vulgare* var. *ferrugineum* Al. *Tam-je* str. 260-368, 4 kart, 7 riss., 14 tabl., bibliografia. (Experiments of a botanical investigation of characters (Jordan) in the limits of a single variety of soft wheat. *Triticum vulgare*, var. *ferrugineum* Al. *Ibidem*, p. 260-366, 4 plates, 7 fig., 14 tabl., bibliography, summary in English).

III. — ORLOV, A. Geografitcheskii zentr proiskhojderia i raivn vozdelyvania tverdoi pchenitzy. *Triticum durum* Desf. *Tam-je*, str 369-459, 12 tabl, bibliogr. (Geographical centre of origin and cultivation of the hard wheats. *Triticum durum* Desf. *Ibidem* p. 369-459, 12 tabl., bibliography, summary in English).

IV. — NICOLAEVA, M. A. Cytologitcheskoe izsledovanie roda *Triticum* *Tam-je* str. 33-44, 1 riss. (Cytological investigation of the genus *Triticum*. *Ibidem*, p. 33-44, 1 fig. summary in English).

V. — PISSAREV, V. Pererojdenie pchenitzy *Tam-je*, str. 59-70. (The degeneraton of wheat. *Ibidem*, p. 59-70, summary in French).

VI. — GOVOROV, L. Priroda razlitchii ozimykh i iarovykh form khlebnykh zlakov v sviazi s voprossom zimostofkosti ozinykh. *Tam-je*, str. 525-559, 14 tab., bibl. (The difference of characters in the winter and spring forms of cereals in relation to the resistance of winter crops. *Ibidem*, p. 525-559, 14 tabl., bibliography, summary in English).

VII. — IAKONCHKINE, Prof. S. Pchenitzy Kryma. *Tam-je*, str. 71-147, 37 tabl. (Wheat of the Crimea, *Ibidem*, p. 71-147, 37 tabl., summary in English).

VIII — ZHUKOVSKY, Prof. P. Persidskaja pchenitza v Zakavkazie. *Tam-je*, str. 45-55, 2 Kart, 7 riss. (Persian wheat (*Triticum persicum*) in the Transcaucasus. *Ibidem*, p. 45-55, 2 pl., 7 fig. summary in English).

IX. — MAKSIMOV, S. Ozimaja pchenitza Rostov. Nakhitchevanskof Opytnoi Selsko Khoziastvennoi stanzii kak sortovodnyi material *Izvestia po Opytnomou Delou Dona i Severnago Kavkaza*. Troudy Selsko-Khoziastvennykh Opytnykh Outchrejdenii. Vypousk 4ii str. 150-163, Rostoffna Donou, 1924. (Winter wheat of the experimental station of Rostoff on Don, as selection material. *Journal of Experimental Agronomy of the region of the Don and the northern Caucasus*, 4th Number, p. 150-163, summary in English, Rostoff on Don, 1924).

X. — NOSSATOVSKY, A. Polskaja pchenitza (*Triticum polonicum*) v Douskom okrouge. *Tam-je*, str. 130-135, 1 riss. (*Triticum polonicum* in the Region of the Don. *Ibidem*, p. 130-135, 1 fig., summary in English).

XI. — KOLMAKOV, S. Tchernooskaja ozimaja pchenitza (*Triticum vulgare* var. *nigroaristatum*). *Tam-je*, Vypousk 6^{ii} str. 135-141 (*Triticum vulgare* var. *nigroaristatum*, *Ibidem* 6th number, summary in English).

XII. — TERNOVSKY, M. Pchenitza Stavropolskof Goubernii. *Troudy po prikladnof botanike i selekzii*. Gossoudarstvennyi Institut Opytnof Agronomii, Tom 13, Vypousk 1, str. 484-508, 15 tabl. Petrograd 1923 (Wheats of the Province of Stavropol. *Bulletin of Applied Botany and Selection*, publication of the Government Institute of Experimental Agronomy, vol. 13, 1st number, p. 481-508, 15 tabl., summary in English, Petrograd, 1923).

XIII. — POPOVA, Mme. G. Vidy Aegilope i ikh massovaja hybridisazia s pchenitzei v Turquestane. *Tam-je*, str. 461-482. (Species of Aegilops and their mass hybridization with wheat in Turkestan. *Ibidem*, p. 461-482, 1 plate, 3 tabl., summary in English).

XIV. — DROSDOV, N. Dikaja i kulturnaja odnozernianka v Krymou. *Tam-je*, str. 515-524, bibliogr. (*Triticum monococcum cereale* Asch in the Crimea. *Ibidem* p. 515-524, bibliography, summary in English).

XV. — FLACHSBERGER, C. *Aegilops triuncialis* L. *nigriaristata*. *Tam-je* str. 483-484. (*Aegilops triuncialis nigriaristata*. *Ibidem*, p. 483-484, summary in English.

The series of Articles here reviewed forms a sufficiently complete collection to judge the importance of the researches made in Russia of recent years.

This chief product of agricultural crops has been studied from the systematic, ecologic, genetic points of view and from that of selection, always bearing in mind the application of the result of these researches to agricultural practice.

The greater part of these researches have been suggested if not di-

rected by Professor VAVILOV of Petrograd ; he it was who gave the general direction to them, he who determined their method, he who is invoked by most of the research workers of his school, it is he and his law of homologous series in variations which they quote on each occasion. His research on the classification of soft wheats has consequently been placed first, especially as he there puts forward new ideas as to the part which the minute investigation of races and lines should play in the classification. His work also is very interesting for the light which it throws on the question of the origin of cultivated wheat, a question still insufficiently examined.

I. — The investigation of a large number of varieties of wheat, from the point of view of their resistance to parasitic diseases, has led Prof. VAVILOV to the conclusion that soft wheats have a great diversity of form easily discernible by their physiological and morphological peculiarities; the botanical lists which only distinguish 22 *Körnicke* or 26 *Flachsberger* varieties give but a small idea of the diversity of the forms which are met with in cultivation and which closer investigation easily brings to light. The writer has collected during his travels in Persia, Bokhara, in Turkestan and the Pamirs, a great number of specimens of soft wheats which were the object of six years research by the writer and his collaborators. Among these specimens he discovered many new forms, which clearly shows the insufficiency of the existing classification.

In his present paper he has tried to correlate the diversity of the characters of varieties with those of other species of cereals on the basis of the law of homologous series in variation (1).

He also attempts to elucidate as much as possible the question of a certain fundamental regularity in the geographical distribution of the various varieties, and to discover the centre and diversity of their origin — a question which has not yet been thoroughly dealt with by investigators.

In the present classification of varieties of soft wheat the principal character is the presence or absence of awns. Now, the writer records that there is in Asia a whole series of spring and winter wheats which have an intermediate character between the bearded and the beardless wheats. These forms indeed have awns, but they are fewer and much shorter than in bearded wheats and the lower portion of the ear is always unprovided with them. The ordinary length of awns in bearded wheats is from 6 to 7 cm., while in the intermediate forms their length varies from 2 to 4 cm.

From the writer's experiments these intermediate forms are easily obtained by crossing *Triticum vulgare lutescens* with *Tr. dicoccum picnurum* ; the semi-aristate forms appear in the second generation and this character continues hereditary and constant in subsequent generations.

The writer considers that, by analogy with the classification of *T. dicoccum* and of barley, this semi-aristate character should be adopted for distinguishing new varieties, for the naming of which the writer proposes the addition of the preposition "*sub*" to the latin name of the corresponding bearded variety. He thus distinguishes the new varieties *sub-ferrugi-*

(1) VAVILOV, N. The Law of Homologous Series in Variation. *Journal of Genetics*, 1922.

neum, sub-graecum, etc. Well known in the classification of barley is the group of varieties which are either unprovided with awns or have very short awns, much curved and enlarged at the base, whose glumes bear an appendix of three lobes forming a rudimentary spikelet (hooded type); to this group belong the varieties *trifurcatum, Horsfordianum* and *laxum*. Now, the writer has found a series of similar mutations in certain varieties of wheat of Chinese and Persian origin. Their glumes have not completely lost their awns but the latter are short, curved and enlarged at their base, while the glume is extraordinarily swollen; this latter character has caused them to be placed in a separate group, including several botanical races, which has been named *inflatum*.

The writer considers that the analogy of these morphological characters of wheat with those of barley is very evident. To make certain of the fact, from a genetic point of view, he has crossed these forms of wheat with bearded and beardless varieties; on repeating the operation he has obtained on the one hand distinctly bearded forms and on the other forms almost devoid of awns, which shows that here is certainly a similar phenomenon to that of the *trifurcatum* type in barley.

The specific character of this mark, the peculiarity of its genetic nature, the ease of its distinction and the analogy with a similar mutation in barley, enables this character to be adopted to distinguish the whole group of *inflatum* varieties, by associating with it other similar varieties which the writer names, for example *albinflatum, rufinflatum, alborubrinflatum*, all having the same character.

Figure No. 126 represents the characteristic types of aristate glumes of varieties of the *inflatum* group opposite those of barley of the *furcatum* group.

It follows from these facts ascertained regarding the semi-aristate wheats and those of the *inflatum* group, that there is full analogy between the cycle of variations in the forms of barley and that of wheat. Indeed, the writer distinguishes the following forms for these two cereals :—

For barley	For soft wheat.
Beardless (*inerme, subinerme, tonsum*)	Beardless (*muticum*)
Aristate (*aristatum*)	Aristate (*aristatum*)
With short beard (*Brachyaterum*)	Semiaristate (*brevi aristatum*)
Trifurcatum	*Inflatum*.

The insufficiency of the present classification of varieties of wheat is clearly shown by the fact that the same variety of ten includes many forms which differ from each other, not only by a single important character, which would suffice for considering them as distinct varieties, but sometimes even by 20 characters.

The present classification of varieties of soft wheat is entirely and exclusively based on the differences of the ear. Now, the writer has found among the various speciments of soft wheat of Afghanistan a series of forms which, while distinguished from one another by more or less important characters, have one character common to all, namely that of

complete absence of ligules and auricles at the place where the leaf blade is attached to its sheath. These forms comprising several varieties constitute, in his opinion, a separate group, similar to the semi-aristate group and the *inflatum* group referred to above. This group of wheat without ligules has a well determined geographical habitat, the centre of which is Afghanistan.

The experiments of crossing made by the writer have enabled him to

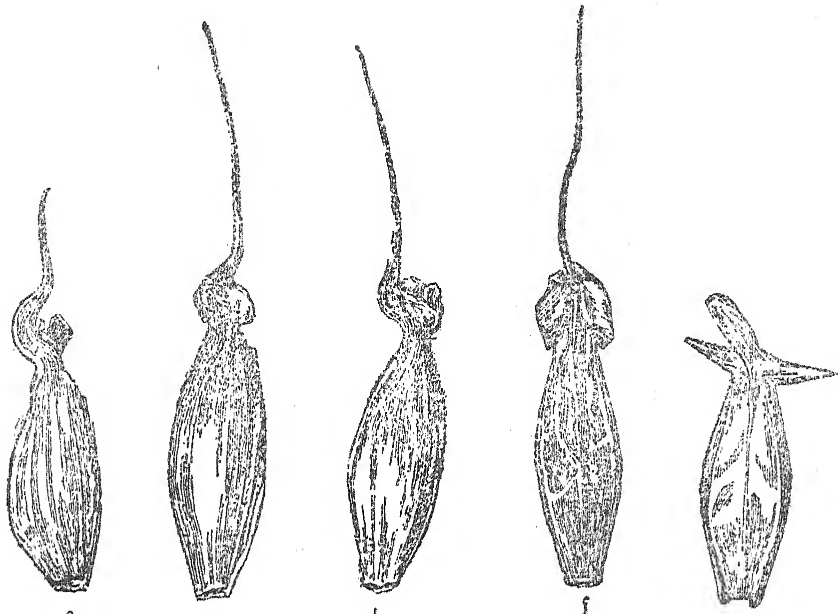

FIG. 126. — Characters of glumes of inflatum group of soft wheats of Persia (1, 2, 3).— Characters of the glumes of " hooded " barley.

verify that the absence of the ligule was indeed, as he expected, a dominant character. Segregation is produced in the second generation, in the proportion of 20 forms provided with ligules to one devoid of them, and that proportion remains constant in spite of the large number of plants of the second generation which amounted to several thousands of individuals.

The writer has also ascertained, as indeed he expected, by reason of the law of homologous series in variations, that the same character — absence of ligules — was also found in plants of oats, rye and maize in the same region, and he thinks that further investigations will lead to its discovery in yet other cereals.

Now, the adoption of the three characters indicated, forming three

new groups of varieties — *breviaristatum, inflatum* and *eligulatum* — already enables 67 varieties of the species *Triticum vulgare* Vill. to be distiinguished, which only had 26 varieties according to the present classifications of KÖRNICKE and FLAKSBERGER. The writer gives the scheme of this new classification, which cannot be reproduced here owing to want of space.

However, in the writer's opinion, these results are not yet satisfactory in spite of the increased number of varieties thus obtained. Indeed, it has already been seen that several varieties include numerous forms which are distinguished from each other by many important characters. It could not, indeed, be otherwise, the variety being itself a conventional unit insufficiently determined and including a conglomeration of races, often presenting very marked differences one from another. The writer considers that it is only this last division, the race, which is a perfectly definite concept really existing in nature. We know that, according to YORDAN and DE VRIEES, a race of autogamous plants is the smallest grouping unit including all individuals with the same morphological and physiological characters which it possesses by reason of heredity, being at the same time all bound up together by their common origin. To establish throughly the characters of a race of autogamous plants, it is necessary to operate with perfectly pure lines and to verify the heredity of distinctive characters in several generations. It is true the race may include in its turn several genetic types and that consequently certain forms of the same race may differ from one another by certain hereditary factors.

The determination of genetic types depends on the accuracy of the detailed hybridological analysis, and it is evidently still impossible for the moment to establish in a certain and complete manner all the hereditary characters which might serve to determine all races of one species or even of a single of its varieties.

The writer has undertaken this work for the races of soft wheat, especially its Asiatic forms, and although he considers his research still incomplete, he has nevertheless already established 66 fundamental characters for the distinction of races, and these characters admitting of further subdivision, their total number reaches 166, all easily recognized, hereditary, constant and independent of local conditions. The schedule of these 166 characters is not reproduced here and only the four groups distinguished by the writer are indicated. To form these groups the writer has taken first of all the complexity of characters which are proper to a grouping of races and which are ordinarily accompanied by a series of other characters united with them by a bond of correlation, while always remaining independent of the influence of their surroundings. What is moreover important to remember is that these complex characters apply also to geographical grouping of races which they denote.

Among these group characters the writer mentions one, by way of example, which is only rather rarely met with in soft wheats — namely the existence of a soft medulla in the upper part of the culm which gives the latter greater strength than usual; the small group of races with this medulla is found in Persia and in Palestine; their distinctive peculi-

arity is generally accompanied by other peculiarities in the structure of the ear and by greater power of resistance to parasitic diseases.

Another character common to a whole group of races is the firm adherence of the grain to the glume, the roughness of the ear and the awns; the forms which have these three characters are xerophytes and belong to the South-West of Asia, while a group of races with smooth awns and which readily drop their grain is more or less localized in the temperate regions of Asia and Europe. The second group of characters is of a mainly qualitative nature; these characters are at the same time quite distinct, independent of conditions of environment and constant in certain well determined races. Such, for example, are the pubescence of leaves, the aspect of young plants, the length of the appendices of sterile glumes, the form of the grain and others.

The writer places in a third group the quantitative characters easily recognized, but fluctuating, which may be determined by comparison between various races grown under the same conditions. Such are the length of the ear and of the awns, that of the stalk, the length and breadth of the leaves, the duration of the growing period, etc. These characters have often great importance from the standpoint of practical agriculture.

To the fourth group belong very fluctuating qualitative characters which, consequently can only be used very cautiously. Although always sufficiently forming the peculiarity of separate races, these characters can only be clearly determined by comparison with other races grown under the same conditions during a series of several years. Such are tillering strength, the consistency of the grain, the yield. In the main, the characters of this group are only distinguished from those of the preceding group by their greater fluctuation and the difficulty of their application for the determination of race.

The writer gives a schedule of characters of different races distributed among these four groups, but this schedule does not include more than 36 characteristics instead of the 66 characters with their 166 subdivisions. The simple reason for this is that these characters are here found collected in complex groupings so as to completely characterize each race.

The writer naturally admits the possibility of a different grouping. Only, he draws attention to the fact that, in order to have a solid basis, the characters of a race should have two principal qualities — constancy and independence of environment. From this point of view he does not approve of the predominant method of basing the characteristics of races on the factors which have great importance from an agricultural standpoint. In fact, these characters are generally very variable, dependent on climate, on qualities of the soil and other local conditions, and are therefore of little use from a botanical point of view. This does not prevent him admitting that sometimes the local conditions may prevail over the power of heredity and determine mutations in the principal characters of a botanically well established race.

The number of races of soft wheat reaches, according to the writer, a figure of several thousands, and most of these races have not yet been

sufficiently studied for it to be possible to give an exact and detailed description of them.

In spite of this enormous diversity, these numerous races may be divided, according to the writer, into three great groups to which he gives the names :— (1) *Indo-European* or *Arian Indo-European* ; (2) *rigidum* with stiff ears; (3) *speltiform.* Each of these groups forms a genetic section and its habitat is well determined. The first predominantes in Europe and Siberia, but it is also found again in isolated mountainous regions of the South-West of Asia.

The *rigidum* group is well localized in the South-West of Asia, in Turkestan, Persia, and Bokhara, but it is also found in Europe and in the North of Asia.

The *speltiform* group belongs more particularly to the South-West of Asia, where it is often grown without irrigation.

In the latter part of his paper the writer deals with the problem of the origin of soft wheats. It is known that, according to the ancient theories, wheat in general had its origin in the regions situated between the Tigris and the Euphrates and afterwards the Caucasus, Persia, and the coast of the Caspian were added to these regions. The writer thinks that it is impossible to solve a problem essentially so complex and that the countries of origin of varieties and races should first of all be discovered. In order to solve this problem according to the method of botanical geography, the habitat of various varieties of a given species must first be determined and in that region must be found the centre of the divergencies which are produced in the greatest number of forms belonging to that variety. According to his investigations, the countries which in spite of all international exchanges, have still preserved the greatest number of endemic forms are precisely the regions of South-West Asia, Persia, Afghanistan, Bokhara, Beluchistan, India, Turkestan and Khiva. He has recorded for these countries the following numbers of varieties of soft wheat :—

Persia 52.
Afghanistan, Bokhara, Beluchistan, 46.
India, 32.
Turkestan and Khiva, 32

The concentration of a great diversity of forms of soft wheat in the South-West of Asia is still more clearly borne out if not only the varieties but also the botanical characters of the different races are considered. The whole of the 66 characters and their 166 subdivisions established by the writer are found in these countries.

The principal centre of all the diversities of races of soft wheats is therefore the South-West of Asia, and it is certainly that region which must be the country of origin of soft wheat. It is therefore in that country which produces, owing to its mountainous regions separated by vast plains, almost all forms of spring and winter soft wheat under the most varied climatic conditions, that the selector should seek for the forms which suit

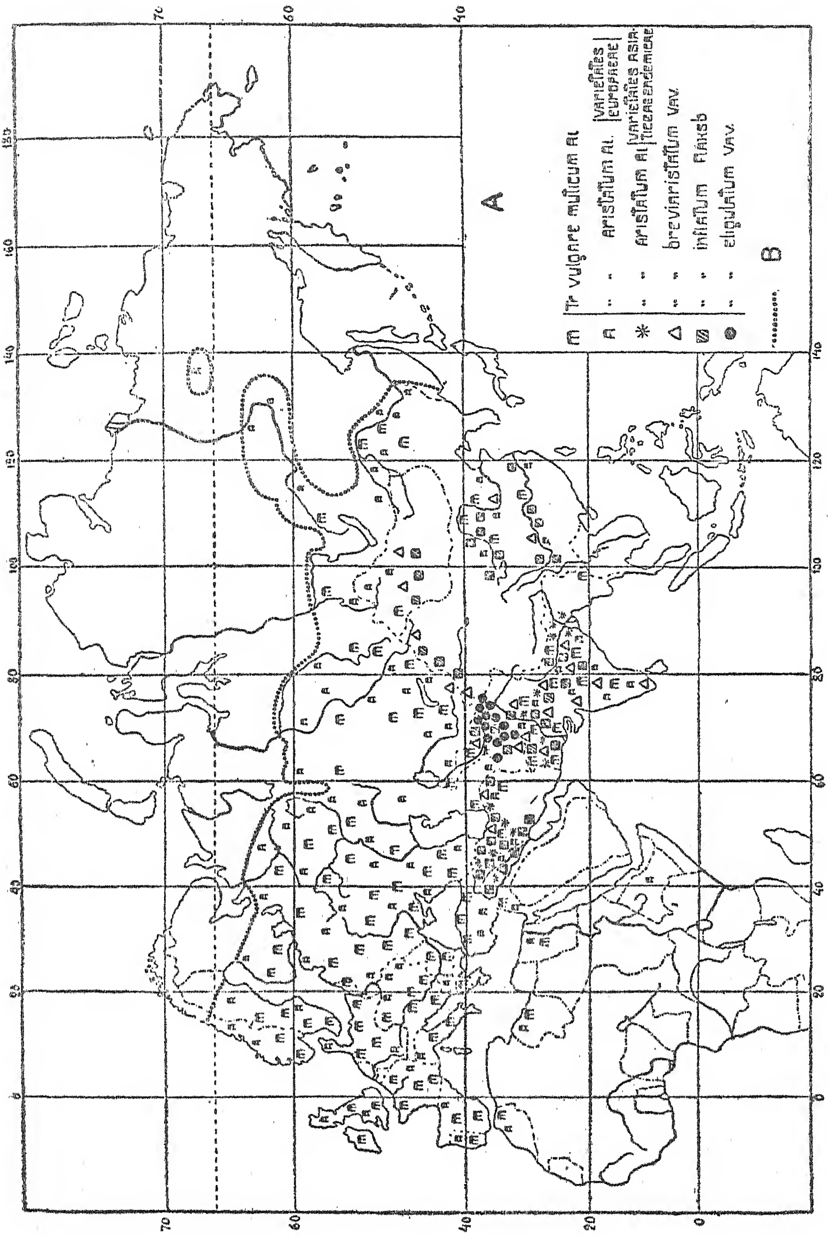

FIG. 127. — Geographical distribution of Botanical varieties of soft wheats in the old world.

him best, whether for direct acclimatization or for crossing and the production of improved races.

II. — The paper by Mme BAROULINA is the result of the application of the principles set out by Prof. VAVILOV regarding the importance of the thorough study of races.

The writer has in view the detailed study of the systematic characters of all forms composing the smallest genetic units (isoreagents according to RAUNKIDER, Iordaneus according to LOTSY) within the limits of a single variety of soft wheat. She has chosen with this object a variety which has many forms and which is very common in regions with the most diverse climates from the South-West of Asia right up to the northern limits of the growth of wheat, sometimes as winter wheat, sometimes on land sown in spring. The variety *ferrugineum* satisfies all these postulates and has the further advantage of having been little modified by selection and of being useful everywhere to determine not only the characters of the variety but even those of the whole species.

The writer has operated on 197 samples coming from all parts of the world, obtaining very pure lines for determining the characters sought for. Her research which has lasted for five years has revealed the existence of an enormous quantity of distinct races and characters within the limits of that single *ferrugineum* variety. Out of 98 specimens of spring wheat the writer has been able to determine 33 races, while 40 forms of winter wheat belonged to 9 different races. Altogether, the writer has found 50 distinct characters which she has divided into 4 groups; these are the characters :— (1) of the ear, (2) of the grain, (3) vegetative and (4) biological.

We shall not follow the writer into the detail of the enumeration of these characters, nor into the schedule of their grouping to form the 42 races which she has determined. It is needless to add that the disciple here follows the arrangement adopted by the master — Prof. VAVILOV — and distributes the 42 races among the 3 groups, *Indo-European*, *rigidum* and *speltiform* mentioned above. The polymorphism of Central Asian wheats is greater than that of European wheats and that of wheats from the temperate regions of Asia. The *rigidum* and *speltiform* groups coming from Central Asia contain the greatest number of forms; out of 14 specimens of the *speltiform* group the writer has recorded 7 races, while she has found 5 races in 9 specimens of *rigidum* and 20 among a hundred specimens of the *Indo-European* group. In this last group the writer distinguishes two further subdivisions :— the Siberian sub-group and that of the Pamirs. This division by groups is, moreover, further applicable to other varieties of soft wheat. The detailed examination of various varieties has shown that all race characters are repeated with great uniformity in all varieties of *Triticum vulgare* and that the direction of variability in these characters is identical.

The four plates here given (Fig. 128-131) show the appearance of the ears, the spikelets of the grains and glumes of four typical races of the *ferrugineum* variety of which one belongs to the *rigidum* group, two to the Indo-European group and the fourth to the *speltiform* group.

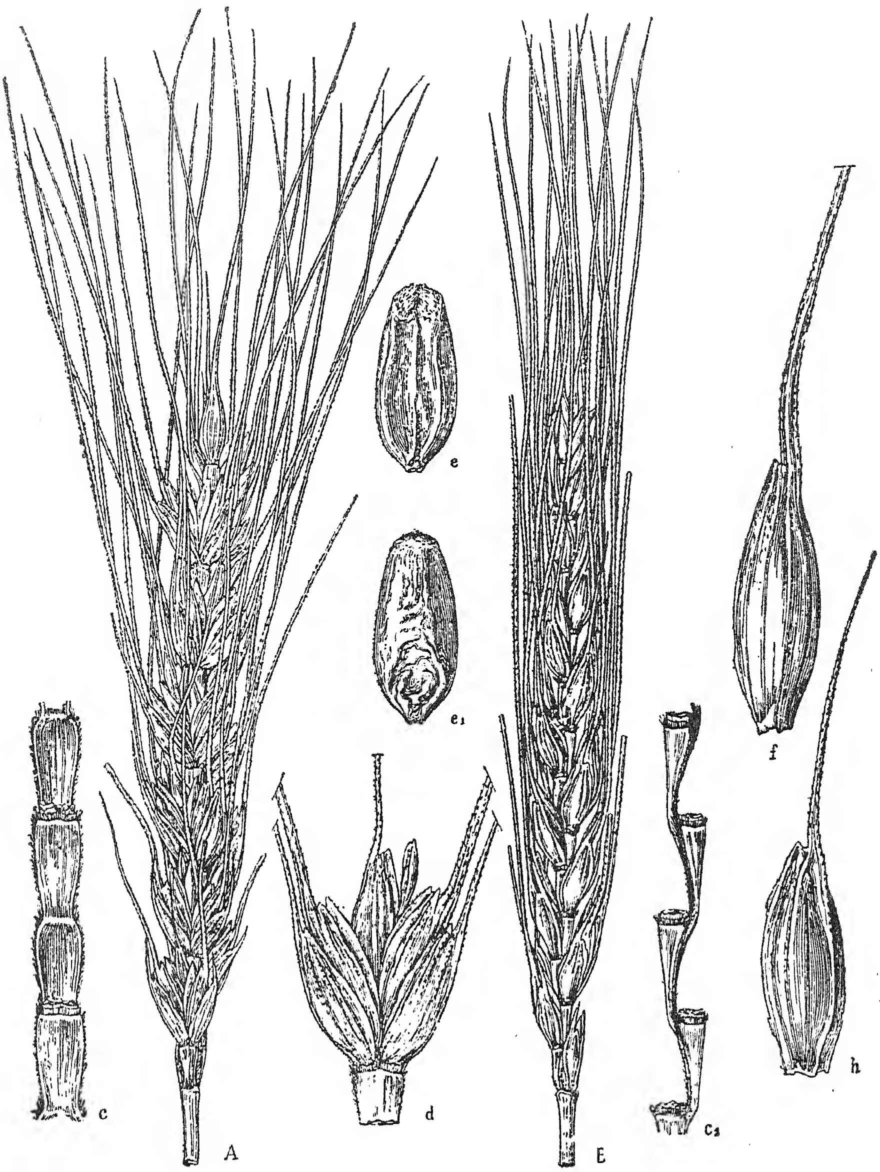

FIG. 128. — *Triticum vulgare* var. *ferrugineum*, *rigidum* group, race of the Bokhara mountains, spring wheat.

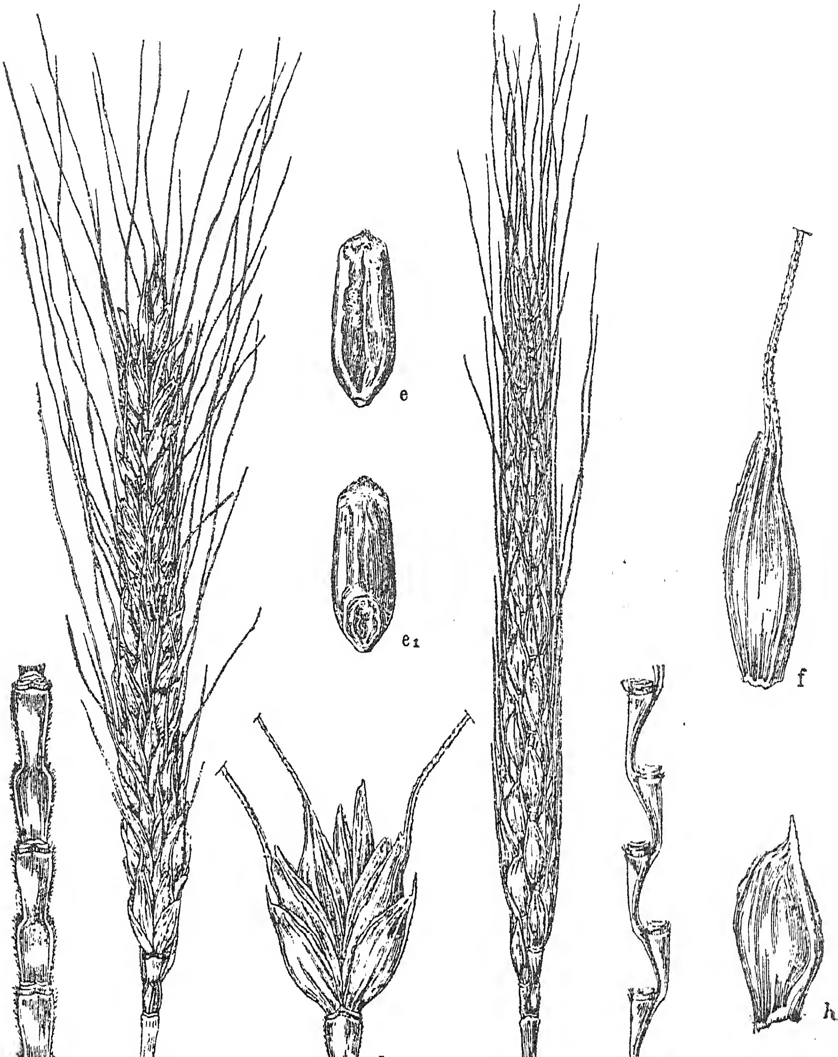

FIG. 129. — *Triticum vulgare* var. *ferrugineum*, *Indo-European* group, race of the Pamirs and of Shougnan, spring wheat.

PLATE XLI

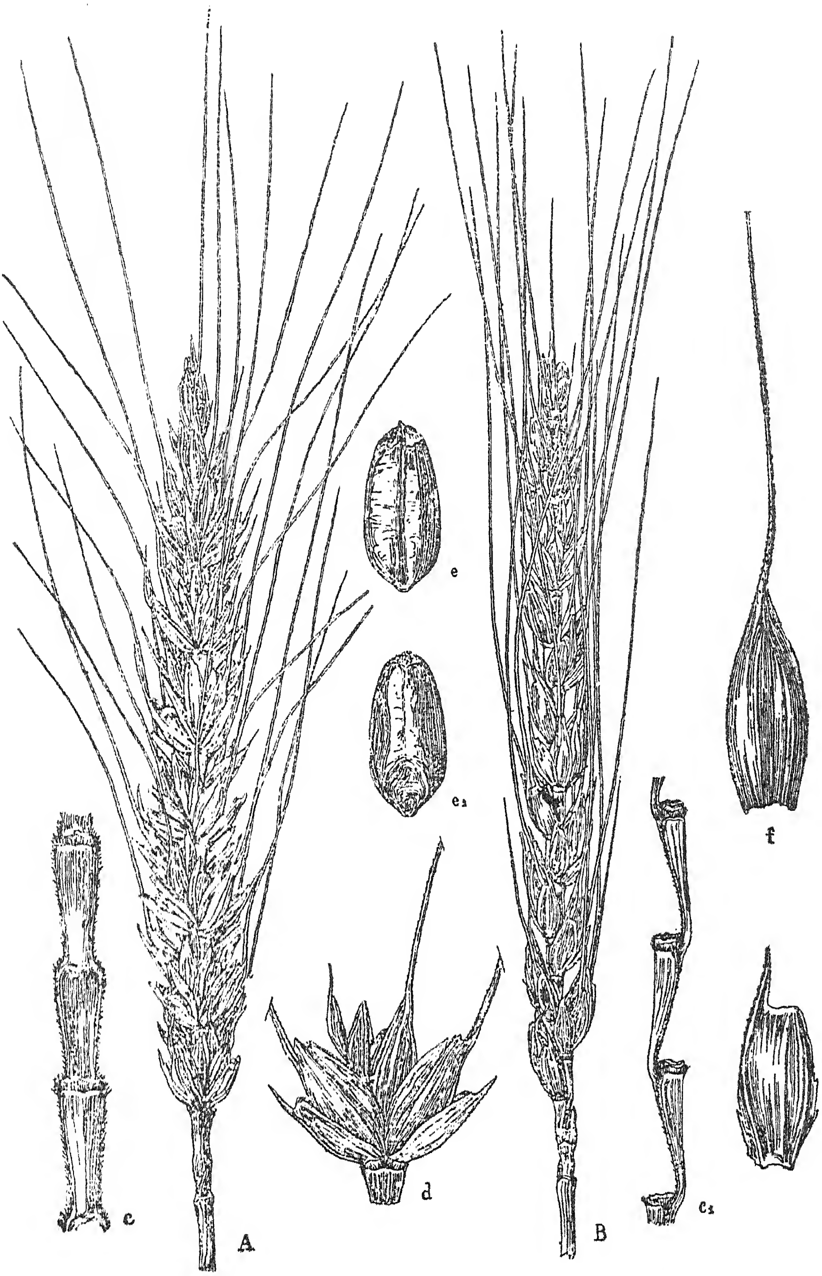

FIG. 130. — *Triticum vulgare* var. *ferrugineum*, *Indo-European* group, Breslau race, spring wheat.

PLATE XLII

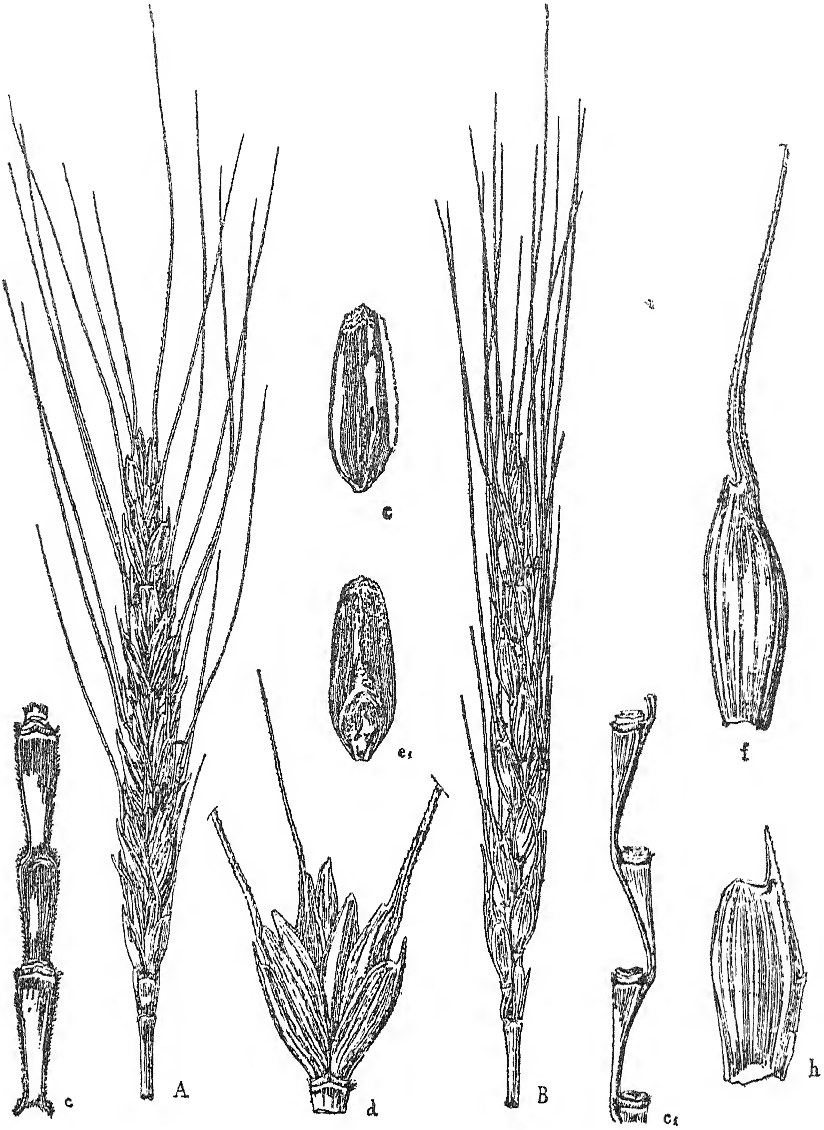

FIG. 131. — *Triticum vulgare* var. *ferrugineum*, *speltiform* group, race of the Bokhara mountains, spring wheat.

III. — Prof. Orlov has attempted a research on hard wheat similar to that of Prof. Vavilov on soft wheat, in order to determine its origin.

The country of origin of hard wheat had not previously been determined. The writer has managed to study a great number of specimens of this wheat and thereby solve this problem. Using the geographical-botanical method, he has determined the geographical distribution of the various botanical forms of this species, and he has then sought out the regions of concentration of his varieties and races, which are the places where the polymorphism of the species is apparent in its greatest intensity and where the greatest quantity of endemic forms are found.

He first records the principal groups of varieties of *Triticum durum*, which are :— 1st the aristate group (*aristatum*) including the most ordinary forms of bearded hard wheat , whose cultivation is very wide spread throughout the world ;

2nd the beardless group (*muticum*) ; these forms have been obtained artificially by crossing ordinary forms of *T. durum* with other species. Consequently this second group is of no use for investigating the country of origin of the species.

The first group is subdivided into two sub-groups which are :—

1st *Aristatum commune*, with high culms, elongated ears, length 6 to 11 times that of breadth.

2nd *Aristatum duro-compactum*, dwarf forms of hard wheat ; the culm is short, the ear very compact, its length does not exceed 4 to 5 times its breadth or thickness.

According to complex hereditary characters, the writer further distinguishes two types of *aristatum commune* :— the *oblongum* type, in which the ear, the glumes and the grains have an elongated form ; the *compactum* type, with short compact ears, with sterile oval glumes, with bulky short grain.

The growth of aristate hard wheat is extremely widespread in Western Europe, Russia, India, Persia, North America, and Australia. Nevertheless, of all parts of the world, Africa stands first for the number of varieties of hard wheat found. That continent, in fact, produces all varieties of *Triticum durum* which have hitherto been described. A large quantity of endemic forms, peculiar to it, are also found there. On the other hand, only 20 varieties of hard wheat are found in Europe, 18 in Asia and 6 in Australia, and no variety has been discovered in these continents which is not also found in Africa.

This distribution of varieties enables Africa to be considered as the original mother-country of the various types of *durum*. Now, the same tokens being recognized in a more detailed investigation of the distribution of hard wheat in Africa, permits the conclusion that its centre of origin is in the North of this continent. Abyssinia, Egypt and Algeria are particularly remarkable for the diversity and abundance of forms which they contain.

In Europe, hard wheat shows a fairly large number of forms in Spain and Italy, in Russia — in the basin of the Don and beyond the Volga and in the Caucasus — in Georgia. Up to the beginning of the XX century it

was Russia which principally supplied the international market with hard wheats, but since then this species has started being grown in large quantities nearly everywhere, especially in America, and even in Australia.

The most widespread varieties are :— *T. durum hordeiforme, coerulescens* and *melanopus* which include also the greatest number of races. *Durum* is pre-eminently a wheat of the steppes ; it is mainly sown as a spring crop. The commercial kinds which give the most abundant yields are :— (1) *Acme*, (2) *Arnautka*, (3) *Monad*, (4) *Buferd*, (5) *Kukauka*, (6) *Trigomocho*, (7) *Medeah*, (8) *Péllissier*, (9) *Arnautka No.* 10 and (10) *hordeiforme Host.*

IV. — Mme. NIKOLAEVA has attempted to apply the cytological method to the botanical classification of the different species and varieties of the genus *Triticum*.

It is known that this genus numbers more than 2000 different races among cultivated plants. Hitherto, three methods were used for establishing genetic distinctions between these numerous kinds, namely :— the study of hybridization and of its products, the serological method and observations on resistance to plant pests which is known as the immunity method. By these three methods 8 species of wheat have been distinguished, which according to the affinity existing between them, were divided into three groups. These species are : *Triticum vulgare* Vill., *Compactum* Host., *Spelta* L., *durum* Desp., *turgidum* L., *dicoccum* Schvank, *polonicum* L. and *monococcum* L. The first three form the first group of which the prototype is soft wheat ; the 4 following species form the group of hard wheats, while *monococcum*, not being able to be placed in either of these groups forms a separate group by itself.

Now the author considered that possibly the structure of the cells would give sufficient factors and new indications for genetic classification. She began by investigating the cells of oats, which present greater facilities, and she deduced therefrom that a certain relationship undoubtedly existed between the number of chromosomes in the cell and the other indices of genetic affinity. An equal number of chromosomes is not necessarily an index of relationship between plants, but an unequal number surely points to the impossibility of crossing, or at least sterility of the hybrids. Mme. NIKOLAEVA carried out her researches on young plantules, which she obtained by the germination of seeds on filter paper. For wheat plantules, this investigation was peculiarly difficult because of the great number of chromosomes and of the peculiar form of the filaments which form a very long system folded over and mixed up in a very complicated manner.

In spite of these difficulties, the writer has suceeded in proving that the number of chromosomes was actually different in the wheats of the three groups mentioned above, while it was equal or approximately equal in species belonging to the same group. As a matter of fact, the writer has ascertained that the first group of soft wheats was characterized by 42-44 chromosomes ; this number was found in the species :— *T. vulgare, spelta* and *compactum*. The metaphases of this latter species however showed sometimes 42-44 and even 50 chromosomes. The writer draws from this

the conclusion that this species may, perhaps, be composite and contain different forms.

The second group invariably contains 28 chromosomes, this number being ascertained in *T. durum, turgidum, polonicum, dicoccum, orientale* and *persicum.*

Lastly, the species *T. monococcum* is distinguished from all the other

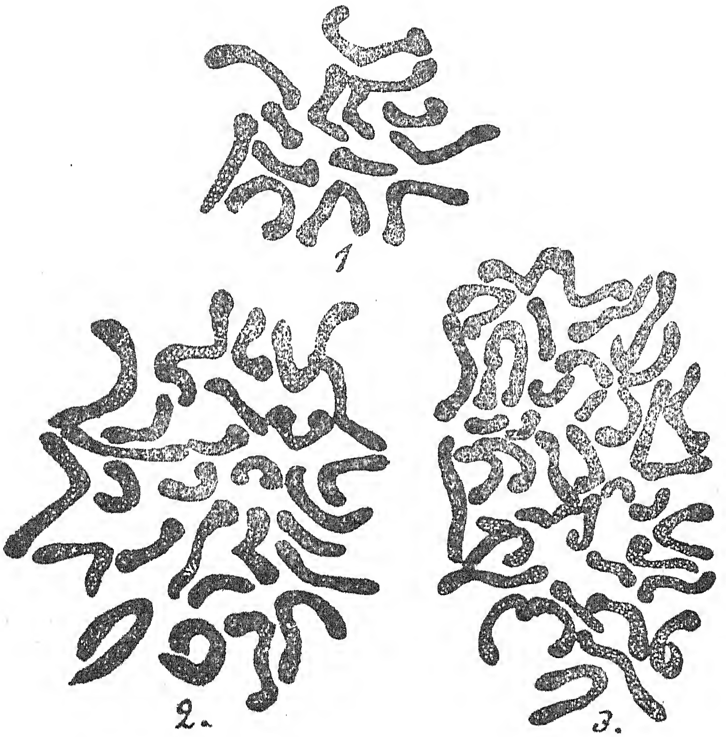

FIG. 132. — (Bulletin of Applied Botany p. 43). Chromosomes in the 3 groups of wheats :—

1.	*Triticum monococcum* L.	14	Chromosomes
2.	*Triticum durum* Desf.	28	»
3.	*Triticum volgare* Vill.	44-42	»

by having only 14 chromosomes ; it should, therefore, form a separate group by itself.

Fig. No. 132 shows the arrangement of chromosomes in the three groups of wheat above mentioned :—

It is therefore important to note the complete parallelism between the results of cytological analysis and those which are obtained by the three other different methods : the hybridological method, the serological

method and the method of immunity give the same grouping of the genus *Triticum*.

V. — Working in the region of the province of Irkutsk in Eastern Siberia, where the climate is particularly hard, M. PISSAREV determined to study closely the phenomenon well known in these regions of the degeneration of wheat introduced from regions with a milder climate and especially from Western Siberia. He began by ascertaining the fact that ordinarily the imported seed contained grains belonging to several botanical varieties, sufficiently near each other however, to form a more or less uniform type of wheat. He chose one of the most common of these types in the seed trade in Siberia which is there known under the name of "*bielokoloska*" (white ear) in distinction to "*kraznokoloska*" (red ear) which has been acclimatized longer to the country. Having taken a sample of seed of imported "*bielokoloska*" he grew it for five years in experimental plots, under conditions as similar as possible to those of ordinary cultivation in open fields.

These experiments resulted at the end of the fifth year, as might have been expected from observations of practical cultivation, in the almost complete transformation of the *bielokoloska* sample into wheat of the *kraznokoloska* type, more suited to the climatic conditions, especially owing to its more rapid ripening and its shorter growing period.

However, botanical analysis of the sample and of its successive derivatives of five years enabled the writer to ascertain that it was not a case of real "degeneration" but simply of the progressive disappearance, at each fresh harvest, of certain botanical varieties composing the sample, while other varieties, more suited to the climatic conditions, multiplied at the expense of the eliminated varieties. The more resistant varieties thus managed to predominate very quickly in the composition of the mixture and completely changed the general aspect of the type grown.

The results of these botanical analyses to determine the composition of the mixture are reproduced in the table below which shows clearly the progress of the process of transformation.

TABLE I. — *Percentage of botanical varieties composing the mixture.*

Varieties	1913	1914	1915	1916	1917
Triticum vulgare var. lutescens . .	72.0	38.8	31.0	23.2	7.6
» » *ferrugineum* . .	10.9	36.5	11.0	49.4	82.4
» » *erythrospermum*.	9.3	13.0	18,4	18.0	5.7
» » *milturum* . . .	6.1	11.7	9.6	9.5	4.3
» *durum* . . . . » *compactum*	1.7	0.0	0.0	0.0	0.0

It is seen that the variety *lutescens* which predominated in the original sample and gave it its *bielokoloska* character, since its ears are light in colour and without awns, is reduced so as to form only 7.6 % of the

mixture at the end of five years. On the other hand, the variety *ferrugineum*, with red bearded ears has become predominant and gives its character to the whole sample, wrongly termed degenerate.

VI. — Many writers have endeavoured to establish a relationship between the resistances of winter cereals and certain visible characters of these plants, such as the violet pigments of the young seedlings, the sprawling appearance of their shoots, the reduced surface of the leaves, their pubescence, the intensity of tillering and the size of the stomata. The experiments of W. GOVOROV on a large collection of varieties of winter wheats have led him to deny the existence of an intimate correlation between the resistance of the plant and its morphological or anatomic characters. At most it may be affirmed that winter wheats possess the above-mentioned characters more often than the others, but the same characters are undoubtedly met with quite as much in wheats which winter badly as in the spring forms. This conclusion might, indeed, have been foreseen in consequence of VAVILOV's law of homologous series of variability, the same variations being in fact repeated in the forms of winter wheats and in those of spring.

The correlation between the quantity of dry matter in the leaves and the resistance to frost, which had been found by SEELHORST and SIUZ, is not confirmed in the writer's experiments.

Several Russian writers had observed the fact that great resistance of winter wheats was accompanied by a great development of the first tillering node above the surface of the soil.

The difference of development of this node is well brought out if the plant is grown in the dark and at a low temperature ; the tillering node is then developed above the soil at a greater distance from the seed in wheats which winter badly, while it is nearer the seed in resistant winter wheats. Spring forms and those which stand wintering badly have this node at a greater height when the temperature is low than when it is high ; resistant wheats, on the other hand, have the node lower when the temperature is low. This shortening of the node is therefore in fairly evident relation to resistance.

The winter resistant forms are distinguished from badly resisting wheat and from spring wheat by higher osmotic pressure of the cell sap, and their leaves contain more glucose at low temperature. However the reservation should be made that the parallelism is not complete in this case between the intensity of these characters, especially of the glucose content and the various degrees of resistance of different species.

The most marked character by which winter wheats with various powers of resistance are distinguished from spring wheats is the degree of variability in the glucose content when the plant is subjected to a considerable change of temperature. A pot culture in the open air has been studied from the middle of August up to the end of September. When the temperature fell to 0°, the plants which happened to be at the tillering period were moved into a greenhouse heated to 15°. The spring wheats showed a considerable loss of glucose, while the winter wheats and even their most delicate forms, did not react at all to the change of temper-

ature. On the other hand, the winter wheats showed an increase in their glucose content when they were moved from a warm temperature to colder air.

On a par with the increase of glucose at low temperatures, a greater decrease in respiration is also noticed in the winter forms. On the contrary, when the temperature rises the spring forms begin to respire more actively than the winter wheats. These differences between winter and spring wheats are more marked at the periods of tillering and of complete growth.

Under the conditions of the Moscow climate the greatest power of resistance to wintering is recorded in the forms which are caused by cold to accumulate more glucose, decrease their respiratory activity and pass most quickly to a state of suspended animation. In this climate the plant perishes under the snow only when oxygen becomes deficient in the soil, for it is only at its expense that it can respire. Lack of oxygen in the soil is ordinarily the consequence, either of too great humidity, or of its excessive pulverization.

VII. — Prof. IAKONCHKINE's paper gives a description of types and varieties of wheat grown in the Crimea and in the province of Taurida, with indication of their geographical distribution and their ecology. The description of processes of cultivation is based on observation, on the results of inquiries and on data found in the literature on the subject. The varieties have been subjected to experimental study ; with this object the writer made as complete a collection as possible of types of wheat grown in the country during his expeditions across the region, and he then grew them in experimental plots. The paper only deals superficially with spring wheat, the growth of which is declining in the Crimea. The writer, however, makes out that the abandonment of that crop is not completely justified. The conditions in the Crimea are certainly much more favourable for winter wheat than for spring wheat, which cannot and ought not to come into competition with the former. But there is no reason for not giving spring wheat preference to barley and oats. Indeed, in respect of resistance to drought, spring wheat is more advantageous than these other two cereals ; the coefficient of evaporation being 441 for the wheat (*bielotouzke* kind), while it is 440 for barley and 480 for oats. Besides, wheat is more adapted to saline soils and stands dust better than barley and oats. The coarse texture of the soil in the fields of Taurida alone constitutes a great hindrance for spring wheat, which is rather exacting and fastidious in this respect . But that coarse texture can and should be got over by cultivation, since it is solely the result of backward and insufficient cultivation.

Among the 90 samples of spring wheat investigated by the writer, the variety *lutescens* always predominated, mixed with a certain amount of the varieties *caesium*, *erythrospermum* and *milturum*. The hard wheats of Northern Taurida belong to the varieties *valenciae*, *leucomelon* and *leucurum*. As regards winter wheat, it predominates especially in the eastern regions of the peninsula, where sometimes the fields of winter wheat cover up to 80 % of the arable area. The cultural processes in

the Crimea are still very primitive and spring fallows are very extensive.

The writer's cultural experiments have dealt with 1000 samples of seeds, collected in the region. 90 % of these seeds belonged to the variety *erythrospermum* and two thirds of the samples only contained that variety without any mixture. The others were chiefly mixed with seeds of the variety *ferrugineum*.

Varieties without awns and those with white grain were rarely met with and velvety varieties were completely lacking. On the other hand varieties with black awns (*nigro-aristatum*) and with black glumes (*caesium* and *nigro-ferrugineum*) were often found ; the writer even discovered a new variety which he has named *nigro-erythrospermum*. Generally speaking Crimean winter wheat is very uniform in type. The richest soils show indeed some diversity in the botanical composition of this type, but the variety *erythrospermum* predominates almost exclusively on the poorer soils. In the Crimea the number of specimens of *Krimka* exceeded by one third that of the *Banatka* type. In Northern Taurida on the other hand the *Banatka* type predominates.

A third type of indigenous winter wheat seems to belong to the *Krimka* kind, the name of which has been forgotten. This type is not frequent and it also is composed almost exclusively of the variety *erythrospermum*.

TABLE II. — *Chief distinguishing Characteristics of "Krimka" and "Banatka"*

	Krimka	Banatka
Length of ear	9.11	10.74
Thickness of ear.	0.84	0.01
No. of full grains per ear.	17.6	17.9
Density	2.13	1.84

Determination of the absolute weight of grains of various varieties has shown that the heaviest grain (40.58 mgs.) belongs to the variety *caesium* ; the second place is held by *ferrugineum* (38.2 mgs.) : next in order followed the varieties *alborubrum* (37 mgs.) and *erythrospermum* (36.3 mgs.) The relatively considerable weight of *alborubrum* has this interest, that in the Crimea wheats without awns rarely give a good grain. To sum up, it may be said that the Crimea is pre-eminently the region of the variety *erythrospermum* and of the type *Krimka*. This type is not much favoured in the market, but it stands drought very well, which makes it an excellent material for selection with a view to the control of this scourge in regions which have an insufficient rainfall.

VIII. — Prof. ZHUKOVSKY begins by recalling that in his monograph on the "Immunity of Plants as regards Infectious Diseases" Prof. VA-

VILOV had determined a new species of wheat, according to Linnaeus, which was up to then unknown to agricultural science and which he had named *Triticum persicum* Vav. The determination was based on the indices furnished by its disease resisting capacity, by hybridological and cytological analysis and by some morphological peculiarities of the new species. As regards its name, it had been chosen from the somewhat uncertain indication of its origin given by the commercial firm which had supplied the grain.

Now, the writer, having specially studied the wheats grown in Transcaucasia, has been able to state that the true home of *T. persicum* Vav. was precisely the centre of Transcaucasia, where he had determined four varieties of this new species.

The species *T. persicum* Vav. is characterized by the following peculiarities :— The ear is similar in its general form to that of *T. vulgare* Vill., but it differs from the latter by the fineness of its culm, by long parallel awns often longer than the ear, by a well filled straw and by a vitreous grain with silvery back.

From a cytological point of view *T. persicum* is characterized by 28 chromosomes and as regards immunity, it entirely resists attacks by *Erysiphe graminis* (grass mildew).

As regards hybridization, this species gives by crossing with *T. vulgare* almost or perfectly sterile hybrids.

The four varieties of this species discovered by the writer have the following characteristics.

1) *Trit. pers.* Vav. var. *stramineum* Zhukovsky, Spica alba, glabra, aristata, caryopsis rubida.

2) *Trit. pers.* Vav. var. *rubiginosum* Zhuk. Spica rubra, glabra, aristata, caryopsis rubida.

3) *Trit. pers.* Vav. var. *coeruleum* Zhuk. Spica coeruleo canescens, villosa, aristata, caryopsis rubida.

4) *Trit. pers.* Vav. var. *fuliginosum* Zhuk. Spica nigra, villosa, aristata, caryopsis rubida.

Fig. No. 133 shows the ears, the aristate glumes and the grains of these four varieties.

Fig. No. 134 shows the arrangement of the chromosomes in these four varieties, compared with that of *T. vulgare* var. *erythrospermum*.

The first three varieties are spring wheats ; the third is only found in small quantities in the damp mountainous regions of the province of Tiflis ; it drops its grain easily.

The variety *fuliginosum* appears in several forms, with long or short ears, with hollow or well filled culms, with grains falling more or less easily. It is one of these forms which has helped VAVILOV to determine the new species. *T. persicum*. The writer considers that the discovery of these varieties confirms the law of homologous series in variations mentioned by Prof. VAVILOV. The farmers of Transcaucasia only use seed of varieties of *T. persicum* for spring sowings, while the autumn sowings are always made with seed of soft wheats.

The *persicum* species do not stand wintering, even in the relatively

Fig. 133. — Varieties of *Triticum persicum* Vav.

[illegible] Zhuk.; F. X — *rubiginosum* Zhuk.; F. XI — Var. *cœruleum* Zhuk.

mild climate of Transcaucasia. On the other hand their quality of early ripening renders them particularly suitable for spring sowings.

IX. — M. Maksimov undertook in 1920 a research on selection of wheat, which he has unfortunately been unable to complete, on account of the entirely insufficient means at the disposal of the experimental station of Rostov Nakhitchevan. He had selected in 1920 on the experimental plot of that station 156 plants of winter wheat, the seed of which he carefully collected. He preferred to make his selection in the experimental plot during the period of growth, in order to determine thoroughly all the peculiarities and the behaviour of the individuals which were to produce the lines destined for the selection research, instead of being content, as usual, to make a selection of seeds. These 156 individuals, forming a well known mixture common in the country under the name of " red

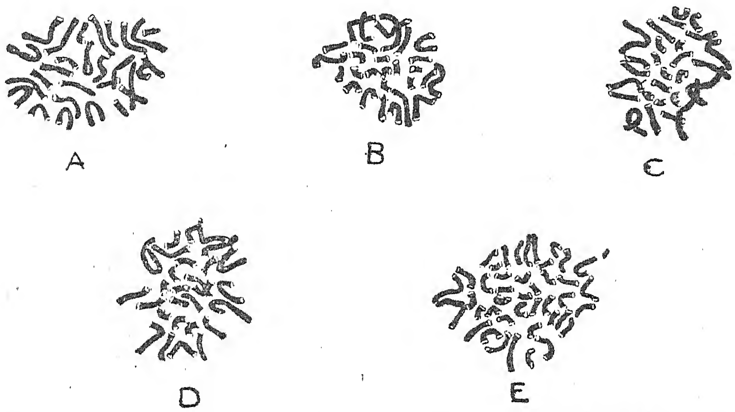

Fig. 134. — Chromosomes of different varieties of *Triticum persicum* — Var.

A = *Trit. persicum stramineum*
B = *Trit. persicum rubiginosum*
C = *Trit. persicum coeruleum*
D = *Trit. persicum fuliginosum*
E = *Trit. vulgare* var. *erythrospermum*.

bearded winter wheat" belonged to the following varieties of *Triticum vulgare* Vill. :—

erythrosphermum	32	individuals
nigro-aristatum	8	»
ferrugineum	26	»
sardorum	6	»
caesium	22	»
hostianum	11	»
barbarossa	24	»
lutescens	16	»
milturum	9	»
pyrothrix	2	»

These plants were sown in the autumn of 1920 in an experimental plot and, after a period of growth under the most unfavourable conditions of intense drought which characterized the spring and summer of the year 1921 in Russia, their seed was carefully harvested, but the work of selection was stopped, as has been said, at this point.

Nevertheless observation of these plants during their growing period and analysis of their seeds have enabled the writer to formulate the following conclusions :— Local kinds of wheat certainly provide excellent material for the work of selection, both on account of the numerous varieties which enter into their composition and for the reason that many of these forms have given good results in experimental plots, in spite of the unfavourable conditions of the spring and summer of 1921.

The lines produced by the seeds of *hostianum* and *barbarossa* have given results which were not inferior to those of other varieties; consequently the commonly-held opinion that these two varieties are unsuited for growth in Russia should be again tested by further research.

X. — The terrible drought of the year 1921 in Russia, followed by the total or partial loss of the harvest in certain regions, necessitated the importation of large quantities of seed grain among which it has been possible to record the presence of new forms and varieties still unknown in the country.

Practical farmers as well as investigators have devoted great attention to testing and studying these new forms of wheat in the hope of finding among them kinds resistant to drought.

Among others hard spring wheat, known as "Polish" wheat, was imported and its growth highly recommended. The writer, M. NOSSATOVSKY, found that these seeds contained a large quantity (up to 50 %) of the variety *Triticum Chrysospermum*, which he subjected to research. This variety is indeed a typical hard wheat, belonging by the length and consistency of its glumes to the species *Triticum polonicum*, but is distinguished from it by certain characters. The culm is long and slender, the last internode is full of pith. The ear in white, not covered, 7.5 cm. long, the awns are 9 cm. long and their colour is the same as that of the ear. The ear contains 11 spikelets, most of which bear two flowers. The glumes are very long, up to 29 mm., and more delicate than those of other hard and soft wheats. The grain is 5-6 mm. long; it is therefore much shorter than in other varieties of *T. polonicum*; its colour is greyish red, its fracture vitreous, the weight of 100 grains is 3.2 gr. The most characteristic feature of this plant is that at the time of flowering the spikelets become detached and deviate from the stalk of the ear until they take up an almost horizontal position; at the same time the glumes open and the gynaecium remains, entirely uncovered, without any protection against the wind and sun. This peculiarity renders the plant very susceptible to drought, from the point of view of its yield. In fact, the yield of *T. polonicum chrysospermum* is entirely inadequate; this variety has only given an average of 1.49 q. per ha. in sample plot, while *T. vulgare lutescens* gave under similar conditions a yield of 5.44 q. per ha.

The writer concludes from this that the use of seed of *T. polonicum*

chrysospermum could not be recommended, especially in regions which often suffer from drought.

XI. — Mr. KOLMAKOV has recorded the presence of a considerable quantity of black bearded wheat in the winter wheat crops of the province of Stavropol. This variety is found in the crops in proportions of from 15 to 35 %. As it very much resembled the variety *erythrospermum*, it was thought that it was only a case of variation of form, or at most of a race differing from the ordinary forms only by the colour of its awns. A more through investigation has enabled it to be ascertained that it is indeed a distinct variety called *T. vulgare* var. *nigro-aristatum*. This variety has white naked ears, but furnished with black awns; the grain is red and vitreous. It is generally found mixed with the varieties *erythrospermum* and *ferrugineum*. Its examination, from the point of view of yield, has given very good results, generally even better than those of the two varieties which it accompanies; the same is true for its tillering capacity, its number of large grains, for the weight of 1000 grains and lastly for the number of grains harvested in proportion to that of grains sown. The writer has concluded that the variety *nigro aristatum* may furnish good material for selection from the point of view of productivity.

XII. — M. TERNOWSKI communicates the results of a botanical analysis, from a morphological, biological, anatomical and physiological point of view of a series of specimens of wheats collected by the experimental station of Stavropol. He gives the characteristics of 11 varieties of *Triticum vulgare*, of 16 varieties of *Triticum durum* and of 1 variety of *Triticum compactum*.

XIII. — Having at her disposal a rich collection of seeds of Aegilops from Turkestan and Persia, Mme POPOVA made a detailed study of them to determine the principal varieties with well defined and hereditary characters. The seeds belonged to four species, namely :— *Aegilops triuncialis* L., *cylindrica* Host., *squarrosa* L., and *crassa* Boiss. The writer determined in this collection 9 varieties of *Aeg. triuncialis*, 6 varieties of *Aeg. cylindrica*, 3 varieties of *Aeg. squarrosa* and 7 varieties of *Aeg. crassa*. She thinks that other varieties of *Aegilops* may yet be eventually found, and that the study of races, which she proposes to deal with, will give much more abundant material.

What is to be remembered for the present is that there exists a striking parallelism between the variability of species of *Aegilops* and that of species of cultivated *Triticum*. We find in *Aegilops* as well as in *Triticum* aristate and beardless varieties, smooth or hairy; with white, red and brown ears, etc. We know that hard wheats are little, or not at all, subject to rust (*Puccinia glumarum* and *P. triticina*) and that their culms are more solid and often filled, while soft wheats are not resistant to that infectious disease and their culms are hollow. Now these same peculiarities are found in *Aegilops*, in which the species *triuncialis* has filled culms and does not suffer from rust, while the species *cylindrica, squarrosa* and *crassa* are very subject to it and have hollow culms.

The writer has also found that *Aeg. triuncialis* is better suited for crossing with hard wheats while soft wheats are crossed more readily with

the other three species of *Aegilops*. He infers from this a complete parallelism of variability between the species of *Aegilops* which grow wild and those of cultivated wheat, which shows that cultivation has no effect in this respect. Experiments of hybridization between *Aegilops* and *Triticum* have been made for a long time and the results are well know. But it has hitherto always been a case of artificial crossing. Now, the writer has recorded in Turkestan, where the genus *Aegilops* is very common in the wild state, a series of cases of natural or spontaneous hybridization between these two genera. Uncultivated land produced a rich growth of *Aegilops*, which gave rise to numerous plants between the wheat furrows as well as on the edges of the furrows. Crossed pollination resulted which produced a great number of hybrids. Most of these were sterile and out of over 300 plants the writer only found 7 which produced seed to the extent of a single seed per plant. Four of these seeds failed to germinate, while three gave rise to plants which grew normally. Two of these young plants after forming ears had an appearance very similar to that of *Aegilops cylindrica*, but the third distinctly showed all the characters of a perfect hybrid. In all probability the parents were on one side *Aeg. cylindrica* and on the other *Triticum vulgare* and the third hybrid had characters intermediate between these two species. The figure 135 represents two specimens of natural hybrids, one of which comes from the spontaneous crossing of *Aegilops cylindrica* with *Triticum vulgare*, and the other from that between *Aegilops crassa* and *Triticum vulgare*.

XIV. — M. DROSDOV has studied a series of specimens of *Triticum monococcum* growing wild in the Crimea near Balaclava. This spontaneous growth was in the presence of numerous plants of *Agropyrum cristatum*, *Festuca ovina*, *Aegilops cylindricum* and *Aegilops ovatum*, all typical plants indicating virgin soil.

The varieties which he determined were :— *T. monoc. boeticum*, *Pancici* and *Larinovi*.

Triticum monococcum is found as a cultivated plant in two regions near Simferopol where the Tartar population sow it as a spring crop for making gruel.

The writer has recorded 4 varieties of this plant, namely, *T. monoc. Symphairopolitanum*, *tauricum*, *eredvianum* and *Hernemanni*.

He thinks that in spite of the inferiority of this grain its growth will still be practised by the Tartars of the poor mountainous regions for a long time. The cereal has, indeed, the advantages of being very resistant to disease, drought and frost, of only needing a rudimentary cultivation and of being content with a marly stony soil.

XV. — Mr. FLACHSBERGER has discovered a new variety of *Aegilops triuncialis* with black awns, whihc he has named *Aeg. triuncialis nigriaristata* and of which he gives the following description :— *Spica aristis nigris vel nigriscentibus. Prov. Transcaspica distr. Askhabad in jugo Kapet Dagh.* He remarks that this discovery shows a fresh confirmation of Prof. VAVILOV's law on homologous series in variation, since varieties of *Triticum* with black awns are well known.

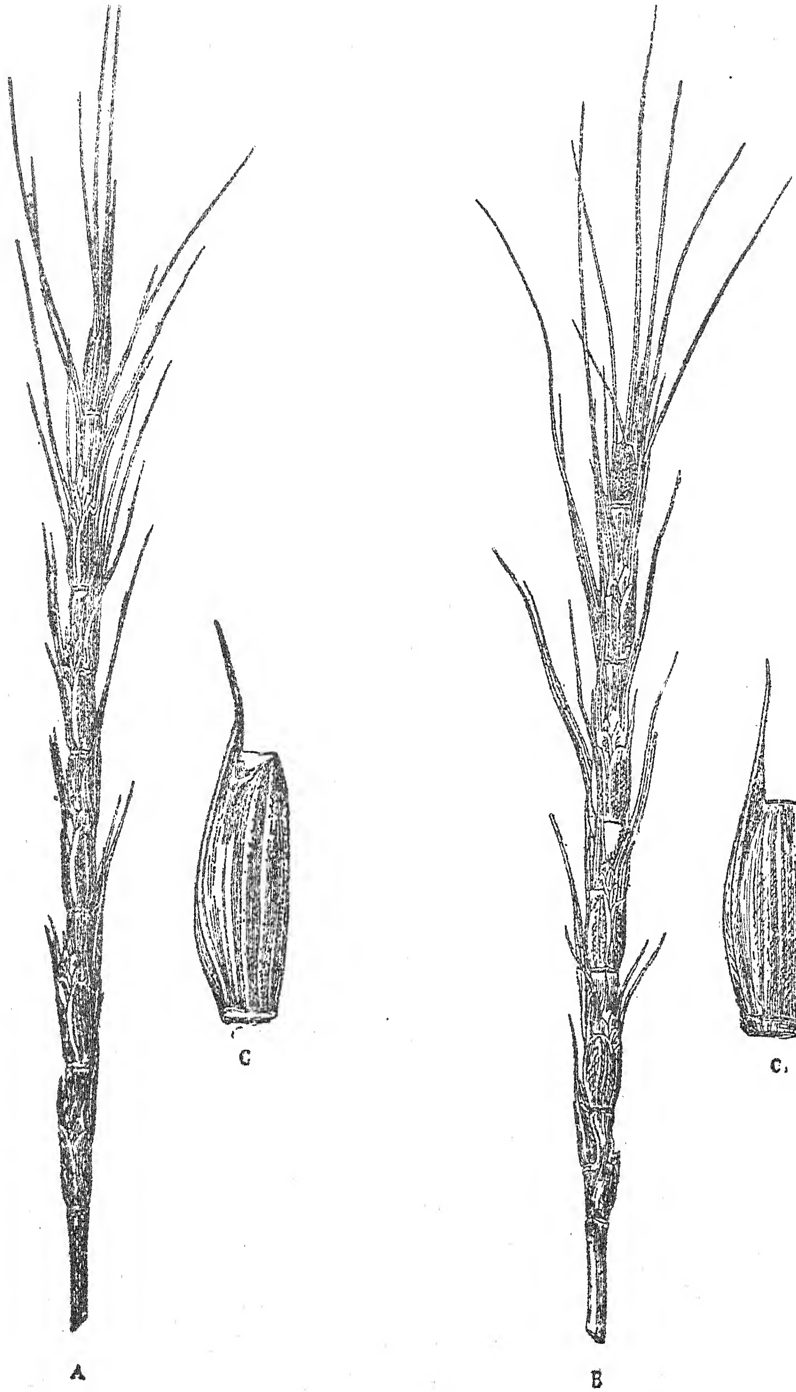

FIG. 135. — A = Natural crossing: *Aegilops cylindrica* × *Triticum vulgare*.
B = Natural crossing: *Aegilops crassa* × *Triticum vulgare*.

617. **Hard Grain Texture as a basis for improving the quality of Early Baart Wheat.**

BRYAN W. E. and PRESSLEY E. H. (Arizona Agricultural Experiment Station). *Journal of American Society of Agronomy*, Vol. XVII, No. 7, pp. 441-443. Geneva, N. Y., 1925.

The term "high quality" of wheat usually implies a grain which produces a high percentage of flour of good baking strength.

Early Baart wheat was imported from Australia, and has been the leading variety in Arizona far at least ten years. At the Agricultural Experiment Station, in the autumrn of 1920, a pedigree strain of Early Baart, No. 34-14, was planted. Some of the seeds were found to be very hard and glassy, while the remainder were soft.

In order to test the stability of the hard texture grain, a single row of 19 plants was planted from the hard seeds, and another row from the soft seed of the same strain. Of the 19 plants from hard seeds, 10 plants only had hard grain.

It was found that grain texture constituted the only visible difference between the hard and soft strains. From each of the ten hard-grained plants a pure hard strain has been established, and these strains have been grown for four years under irrigation, and are as hard as the grains originally selected.

Milling tests of the hard strains have been made from the 1923 and 1924 crops ; the hard strains differ from the soft in two factors only, absorption and percentage of gluten. The hard strains are about 6 % higher in absorption and 2 % higher in gluten than the soft Baart. The higher absorption of the hard strains gives a greater bread yield. W. S. G.

618. **Quantity and germinating power of wheat in relation to the threshing period.**

MORETTINI, A. Influenza dell'epoca della trebbiatura sulla quantità e germinabilità del frumento. *Le Stazioni sperimentali agrarie italiane*, v. LVIII, p. 1-6, p. 161-182, bibl. Modena, 1925.

From the time of reaping until threshing wheat is kept in the ear and stored in different ways according to the district. During the said period it may suffer injuries varying with the year by the operation of different agents. Among these may be enumerated :— the phenomenon of the germination of the grain in the ear, dependent on well determined changes of weather, and more especially damage by insects which considerably and seriously affects the quantity and quality of the grain as well as its germination

The researches made by the writer in the middle Valley of the Tiber (Umbria) tend to prove conclusively that mechanical threshing, done with common threshing machines for soft wheats, does not sensibly injure the power of germination and that the grains broken by the thresher do not usually exceed one per cent. On the other hand, the damage which occurs to wheat owing to delay in threshing (beyond 26 days from reaping)

is serious, because we then get invasion by the larva of *Sitotroga cerealella* which, in certain years, may reduce the germinating power of the grain to 30 % and cause a loss in weight of 15 %. The importance of this damage generally escapes notice, because, with winnowing and sifting, a large part of the damaged grain is eliminated with the chaff and taken away with the refuse. It is therefore advisable to thresh as early as possible.

By means of mechanical sorting, and especially by winnowing, a lot damaged by *Sitotroga* may be improved so as to render the grain fit for sowing, but only if the attack is slight. A. F.

619. **Research on variability in the "Burt" oat.**

COFFMAN, F. A., PARKER, J. H., and QUISENBERRY, K. S. (Office of Cereal investigation, Bureau of Plant Industry). A Study of Variability in the Burt Oat. *Journal of Agricultural Research*, vol. XXX, No. 1, p. 1-64, 9 tab., bibl. Washington D. C., 1925.

The "Burt" variety of oats is one of the chief red oats and it is regarded as having been created by a certain BURT, hence its name. It is widely adaptable and grown for industrial purposes in the South-West of the United States. It is very subject to variations and difficult to classify; probably the varieties known under the names of "May", "Early Ripe" and "June" belong to it. It has a great economic value by reason of its wide adaptability, early ripening and resistance to rust and smut. This variety has been classified as *Avena sativa* and as *A. sterilis*. According to the writers it belongs to *A. byzantina*, the species in which European taxonomists include the cultivated descendants of *A. sterilis*. It certainly contains some stock much resembling *A. sativa*. It is however not improbable that many spontaneous crossings have taken place.

Besides the character of the spikelets which are of very great importance, the writers have observed that this variety undergoes variations in various characters, such as in the *habit* of growth of the young plant, in the colour and size of the leaves, in the time of ripening, etc.

There are also distinct variants, among them one showing a pale condition of leaf, another with many flowered spikelets, one with free glumes, etc.

The writers show the utility and possibility of isolating relatively pure stocks, by continuing selection for several years. A. F.

620. **Bean Culture in Norway.**

BREMER A. H. *Meldinger fra Norges Landbrukshøiskole*, No. 7, 1924, pp. 317-366, bibliography. Oslo, 1925.

The growing of *Phaseolus vulgare P. multiflorus*, and similar varieties of beans has increased rapidly during the past twenty-five years, owing to the successful results of plant-breeding, which has placed on the market new varieties especially suited to Norwegian climatic conditions.

Amongst dwarf beans, the varieties "Nordstjer" and "Alabaster"

have proved the best. The Norwegian strain of Erstling "Reistad" gives a high yield and ripens early. Early maturity is very important owing to the shortness of the summer, which makes it very difficult to obtain well-ripened seed, also the failure of seed to germinate from damage caused by disease is a serious difficulty. W. S. G.

Tropical and other commercial plants.

621. **Cotton growing in Cilicia.**

VILMORI, P. L. de. La culture du cotonnier en Cilicie. *Revue d'Histoire Naturelle appliquée*, v. VI, No. 2, p. 53-64, Paris, February 1925.

The writer examines the general conditions of the region which occupies an area of about 50 000 square km.: the growth of cotton there is nothing new having been introduced from India, but its exportation dates back to about 20 years ago. In 1908, 60 000 bales, of about 2 quintals, were exported: in 1912, 100 000 bales, 120 000 in 1913 and 135 000 in 1914. Consequent to the outbreak of war, production fell to 15 000 bales in 1915, 18 000 in 1917, 15 000 in 1918, in 1919 to 24 000 and in 1922 to 28 000. The writer, in 1924 when he made his journey of investigation in the region, estimated the crop at about 60 000 bales.

The species grown are: *Gossypium herbaceum* and *G. hirsutum*. The former species is called "yerli" and was introduced about a century ago; it is grown without selection, sown broadcast, with primitive methods, so that the yield is rather small, not exceeding 50 kg. per ha.: the capsules, have the peculiarity of being but slightly dehiscent and the seeds are fairly adherent to the capsule; these characteristic peculiarities enable picking to be spread over a long period of time, and done when convenient, while the removal of the seeds is done by hand by women in winter: in a country where manual labour is so scarce these peculiarities have the greatest importance.

G. hirsutum (Upland type with short staple), called "yanè", was introduced about 40 years ago: it does not present appreciable modifications, but is less productive.

In Cilicia, it is not really possible to distinguish special cotton zones, as cotton is grown everywhere. The best soils are the argillaceous alluvial soils containing up to 20 % o carbonate of lime: their colours vary from grey (presence of much carbonate of lime) to black and red, the red soils containing salts of iron and chromium. Subterraneous water is abundant throughout the Adana plain, thus the cotton, owing to moisture in the sub-soil, can stand the extraordinarily dry summers. The cultural methods are rather primitive: the Germans, during the war, taught modern methods, consisting especially in deeper tillage of the soil, and large proprietors carry out deep tillage with machines, but according to ACHARD, this is more injurious than useful, as helping the dessication of the subsoil.

Chemical manures are not used: stable manure is used in nurseries, rarely for large crops, but this stable manure has little value, because it contains not straw but fine earth.

The growth of cereals follows that of cotton. In some regions, owing to scarcity of manual labour excellent land is obliged to be left uncultivated for one or two years. " Bersim " and the groundnut might be introduced into Cilicia with good results. The principal cotton pests have come from America : *Earias insulana*, and *E. faba*, *Harpator iracundus* and lastly the pink boll worm or *Gelechia Gossypiella*. The methods of preparation of the land are as yet imperfect ; the removal of the seed is effected for large crops with the Platt machine with cylinders.

The principal types of Cilician cotton are :— Yanè, Kapoumali, Supérieur, Extrissima, Extra (these last four belong to the " yerli " cotton).

On the 22nd December 1924, the price of Good Middling at Havre being 880 frcs. per 50 kg., their values were :— Yanè 670-680, Kapoumali 650, Superieur 640, Extrissima 625, Extra 610.

Cilicia is therefore a region fairly near to Europe, and within easy reach and with a great future for cotton. If Turkey lives in peace for a few decades its production might be estimated at not less than 80 000 tons. But great improvements must be made, especially in cultural methods.

F. C.

622. **Gums and balsams of Indochina.**

CREVOST, Ch. *Bulletin Économique de l'Indochine*, year XXVIII, No. 172, 1925-III, p. 283-317, 16 pl. Hanoy, 1925.

The economical review of Indochina, continuing the publication of the catalogue of the products of Indochina, has published the part dealing with the gums and balsams of Indochina.

A) *Gums*.

Gums are substances soluble in water, with which they form thick and fibrous mucilages. They are divided into three classes :

I. — *Real gums* (*type gum-arabic*). These swell rather in water, and dissolve entirely or partially.

II. — *Mixed gums* (*pseudo-gums*). Their solubility is small. They swell considerably in water without dissolving *e. g.* Tragacanth.

III. — *Tanno-gums or Kino* containing, besides the elements which form mucilaginous solutions with the water, also gallic acid and tannins. The author has adopted for the study of gums a classification into botanical families :

Biscacées : *Cochlospermum gossypium* D. C., var. *cambodiana* Gagnep : its gum is a product to be studied.

Guttiferous : Gutta-percha. Indochina counts no less than 22 kinds of *Garcinia*, of which most on being cut produce gums of different sorts, more or less coloured and consequently more or less capable of use.

Among the gums, special attention must be drawn to the gutta-percha which forms an excellent commercial product of Indochina. It is found in the following trees :

Garcinia Hamburyi, Hook, f. ; syn. *G. morella*, var. *pedicellata* Hamb., a tree, 10-15 metres high, found in Cambodia in the provinces of Pursat. Kompongspen (Khands of Somrong-tong and of Thpong), of Kampot, etc, and on the Phu-quôc island.

According to certain Cambodians, 50 trees produced 37 ½ kgs. in 5 months or 0.750 kgs. per tree every two years. A Chinese buyer who was in close touch with a settlement using this product, told PIERRE that the production of one tree was not less than 2 kgs. This tree, which he pointed out as being able to give that production, was 32 years old, already exploited and its bark had a thickness of 4 mm. PIERRE has actually seen trees, 10-12 years of age, whose diameter was not more than 6 cm and which already had been tapped. Consequently he thinks it possible to start tapping *garcinias* when they are 5 or 6 years old. Gutta-percha is completely dissolved by the action of ether and water ; it is used for colouring numerous spirit and turpentine varnishes ; it is also used in water colour painting. One finds in the market of Saigoun two qualities of gutta-percha, the first quality gum is nearly pure, its breaking is conchoidal, smooth, and brilliant, the colour dark yellow-orange, becoming light yellow when one rubs it with a wet finger. It is sold in cylinders of a diameter of 3-4 cm. and a length of 12-15 cm., the second quality gum is spoiled by scraps of bark ; it is sold in irregular lumps or in small pieces. The average annual export from Indo-China of Gutta-percha during the years 1919-1923 was about 13 700 kg.

During 1923 the exports amounted to 17 000 kg. of which 11 000 kg. were to Singapore, 3200 kg. to France, 1350 to England, 1000 to Hongkong and the remainder divided between Belgium and Siam.

1st class gutta-percha was in Cochinchina valued at 250 piastres per 100 kg. in December 1924 ; the price of the second quality is generally from 30-40 piastres less.

Garcinia Gandichandii Planch. and Triana, a forest species 3-10 metres high. — Cochinchina, Annam and Laos — Seldom cultivated.

Garcinia tonkinensis Vesque, a beautiful tree, cultivated in Tonkin for its oil-seeds and not for its gum ; the last according to Dr. F. HEIM might be of great interest for the stiffening and the printing of textile fabrics.

Sterculiacees. — Some Sterculia, among the 30 kinds known in Indo-china, produce now and then a white-yellowish gum, which the Annamites are very keen on taking, as their pharmacopoeia appreciates it highly for chewing.

Rutacees. — The gum-producing Rutacees are very numerous, those worth notice being : *Aegle marmelos* corr — *Feronia elephantum* corr. — *Zanthokylum piperitum* D. C.

Meliacées — *Melia azedarach* L. (Japanese lilacs) and *Melia azadirachta* L. These two kinds are spread through the different countries of Indo-china ; they are planted in the middle and at the sides of the roads. Some planters of Tonkin have made special plantations of *Melia azadarach* : the nature of its wood and its rapid growth make it very suitable for the construction of mine-galleries.

One fairly often sees long gum drops on the trees, light-yellow in colour and brilliant, and these dissolve almost completely in water.

Chukrasia tabularis A. Juss. Anacardiacées — *Buchanania latifolia*, Roseb. A very common tree in all the southern parts of Indochina, Burma and India with seeds having a taste of pistacchio. According to J. de CORDEMOY, the gum of this tree is very highly appreciated in India. A well grown tree could yearly give a little more than 2 kg. The gum is crumbly, of a light colour or pale brown, tasteless ; it is largely soluble in water. The solution, which contains only a small proportion of insoluble elements, possesses adhesive qualities, quite comparable to those of gum arabic. The author thinks that this product might attain a real commercial value :

Odina Wodier Roseb. *Bonea burmanica* Griff — *Anacardium occidentale* L.

Leguminosae. — It is the *Acacia* genus and specially the African kinds of this genus, found in Egypt, in Soudan, Senegal and along the coast of Somaliland up to the Cape of Good Hope, which gives the European markets their biggest supply of gum arabic. Indochina has got about ten sorts of *Acacia*, wide-spread through her territory, but the absence of research on the subject makes it impossible at the present moment to give any indication of the nature of the gum of these trees. Among the best known sorts the author mentions :

Acacia Farnesiana, Wild. — *A. arabica* Wild. — *Butea frondosa* Roxb. (the gum of this tree is very rich in tannin) *B. superba* Roxb.

The following kinds are also mentioned : *Pterocarpus indicus* Wild. — *Pt. pedatus* Pierre — *Pt. cambodianus* Pierre — *Pt. macrocarpus* Kurz.

Lauraceae. — Some lauraceae possess in their wood gum-mucilaginous substances, which, though they are not be found on the bark of the tree in a state of secretion, are not less interesting to commerce. Such is the property of *Litsea sebifera* Pers. A tree of about 12-15 metres high, well known in Indo-China and cultivated in certain provinces (provinces of Nord-Annam) for the use of its oil-seeds, which on being crushed yield a concrete yellow material, serving for lighting purposes.

B) *Balsams.*

The pharmacologists, agreeing with the chemists, restrict the denomination of the balsams to the natural products, of which the average composition is the following : resin, volatile oil, and one or more acids of the aromatic series, generally benzoic acid and cinnamic acid.

Benzoin. — The Indochina economic agency at Paris has recently published a study on the benzoin of Indo-China, called " Benzoin of Siam ". The sort observed at Tonkin by BALANSA (*Authostyrax tonkinense*) should correspond with the *Styrax tonkinense* of PIERRE, " Bô-dê " of the Tonkinese, and this sort, cultivated in Laos for its benzoin under the name of " Kok Nham ", would appear to be much more widely spread. It is to be found in Tonkin, in the provinces of Hoà-binh, Sonla, Phu-tho, Thài-nguyên, Tuyên-quang Yên-bay and those of Nord-Annam, where

it is only cultivated to supply the wood for making matches. *Styrax tonkinense* Pierre = *Anthostyrax tonkinense* Balansa.

Benzoin gives out a fine perfume, somewhat like that of vanilla, a quality making it much in demand for the making of perfumes. It melts in the fire, spreading a very strong odour , it is soluble in alcohol and ether.

Indochinese exports of benzoin during the period 1909-1923.

Year	Quintals	Year	Quintals	Year	Quintals
1909	239	1914	162	1919	410
1910	265	1915	162	1920	265
1911	592	1916	76	1921	176
1912	1 126	1917	52	1922	396
1913	1 336	1918	4	1923	377
Total . . .	3 558		456		1 624
Average annual export.	715		91		325

The exports during the year 1923 are divided as follows :

Laos, by Tonkin, 201 quintals ;

Laos and Cambodia, by Cochin-China, 176 quintals.

The benzoin of Laos follows many trade routes : the production of the Hona-Phans, formerly nearly entirely directed along Thanh-hoa (Annam) by Sam-Tu, takes more and more the road of Cho-bo (Tonkin).

The buyers even send their agents on the roads leading to the market in order to get the material, before it reaches that place ; on the other hand part of the production of Luang-Prabang is forwarded to Cochinchina, while another lot passes the Indochinese frontier to be shipped at Bangkok, where it raises the export quota of this country under the commercial name of " Benzoin of Siam ".

The packing of the benzoin is a very delicate operation, as it is apt to break very easily and especially to form into lumps : it is a commodity which must be labelled : " to be kept away from the boilers ".

The exporters take very great care in packing : some wrap the layers of the three first qualities in very soft native paper and afterwards in tin plate boxes ; others wrap the boxes containing the different kinds round with paddy husks in order to weaken the influence of the heat which might cause the drops and especially the small scraps to form into lumps.

P. C.

(*Correspondence Bureau of Indochina*).

623. Variations in the sugar content and in the rate of growth of beet in consequence of rain.

URBAN, J. (Forschungs-Institut der Csl. Zuckerindustrie). Ueber Aenderungen im Zuckergehalt und in der Wachstumsgeschwindigkeit der Ruben als Folge verschiedener Wasserniederschläge. *Zeit. f. die Zuckerindustrie der ce-*

choslovakischen Republik, Year XLIX, No. 39-40, p. 299-305 and 307-312, 1 fig., 10 tab. Prague, 1925.

The writer has made use of data furnished by 6200 analyses made during five years in sugar factories in Czechoslovakia and has correlated the analytical results with the rainfall conditions. It is observed that the sugar content shows its maximum increase after a dry week preceded by a wet one (20 mm.) ; this increase was on the average 0.80 % and in one year amounted to 1 19 %. When a dry week was preceded by another dry week, the increase was 0.75 %.

With continuous rain, the gain in sugar content is reduced with a certain regularity so that, after a rainfall of 27 mm., the sugar content remains as it was at the end of the first week and is reduced below this limit after still heavier rain.

There may be a decrease in the sugar content also with a rainfall less than 27 mm., when the beet has a scanty sugar content and the leaves have withered The decrease in sugar content caused by abundant rain averaged on the five years 11 % with 35 mm. of rain ; in a dry year (1921) it amounted to 1.12 %.

The sugar content is more stable, that is it resists the decrease better, when the root and the leaves are well-developed and fresh. Vice versa the more the beet is dried up, the more easily the sugar content decreases after rain, in consequence of the weakening of assimilation in rainy weather. As regards the *rate of growth*, it is observed that this varies in direct proportion to the rainfall of the same week and of the previous week. The smallest weekly increase (g. 20.7) was observed in the average of the five years during a dry week preceded by another dry week. With continuously increasing rain, the rate of increase in weight of the root becomes quicker, though it slows down again afterwards. The greatest weekly increase (g. 38.3) was observed in sunny weather after a heavy rainfall of 37 mm., when therefore the beet had sufficient moisture.

The greatest elaboration of sugar in the root took place in a dry week preceded by a wet one. The best conditions for the production of sugar exist when, after a rainy period, the weather becomes fine; in such a case the average weekly increase was g. 7.62. On the other hand during a rainy week the production of sugar fell in such a degree that during a rainfall of 35 mm. the gain in sugar was only g. 4.89 or 64 % of the maximum production. In the same conditions the elaboration of sugar is smaller when the leaves are less developed A. F.

624. **Tests of Sugar Beets.**

DOWN E. C. *Michigan Agricultural College Experiment Station Bulletin* No. 66, p. 8, tables 6. East Lansing, Mich., 192[illegible]

The Bulletin contains a report on three years' work on 23 samples of sugar beet of different varieties and from various sources. The average yield, sugar percentage, purity coefficient and total sugar recoverable are given for the strains tested.

The average total sugar recoverable per acre for the leading varieties was: German Elite 2242 lb., Zapotel Seed 2138 lb., Czecho-Slovakia 2106 lb., Canadian 2090, G. D. Z. 2074, Michigan Grown 2000.

Michigan grown seed from commercially grown foreign seed, without selection, results in a beet with comparatively high tonnage, low sugar and low purity.

A variety of sugar beet should not be grown because of high sugar content alone, but should be tested for tonnage and purity coefficient.

W. S. G.

Horticulture and forestry.

625. **Frnit growing in Italy.**

BASSI, EDOARDO. Frutticoltura italiana. One vol. 16°. p. 358. figs. C. Tarantola ed. Piacenza, 1925.

The principles and informative criteria to which modern fruit-growing arboriculture must be subjected are expounded in this volume.

The first part contains ideas of general fruit-growing, types of fruit-farming and methods, the care to be given to the trees; with a widely developed discussion on pruning. The second part is devoted to special fruit-growing and deals with trees bearing stone fruits (peach, apricot, cherry, plum) and fruits with pips (apple, pear). Hints on methods of cultivation, harvesting, packing, preservation and especially regarding diseases are given clearly. In recapitulatory chapters, at the end, the Author, in addition to dealing with the manuring of fruit trees and arboreal medicine, gives standards for ascertaining the productivity of an orchard and suggests a radical reform in the propagation of fruit trees, based on the genealogical selection of the grafting stock.

A. F.

626. **Orange grafting in Suriname.**

STAHEL, G. Het veredeln der sinaasappels in Suriname. *De Indische Mercur*, year 48, No. 2, p. 15-16, fig. 12. Amsterdam, 1925.

The necessity of a greater production of oranges in the Dutch Indies was specially felt during the war when European markets were closed. Now oranges from the Indies are being sent to Europe, but they have to meet competition, especially of South African oranges, hence the necessity of arranging for a good and more especially a standardized production.

Among the various varieties "Washington Navels" is not recommendable because the fruit is not juicy. "Lambs summers" gives good fruit, but it is only suitable for local consumption, because the thin skin soon becomes hard and leathery and prevents export to a distance.

For important varieties it is therefore better to have recourse to local kinds, among which there are some which produce fruit of very good quality; among these may be mentioned the varieties:— Sorgoliet, La Liberté and Kwatta. There then remains the question of stock for grafting on to, for which the bitter orange and the "alamoen", a variety of *Citrus de-*

cumana, are recommendable. The latter, indeed, in the damp climate of Suriname, easily becomes subject to the gum disease, but other varieties are still more easily attacked by this disease.

As regards the method of grafting the cutting like an inverted T is advisable ; but this is not suitable for the " alamoen " for which FORKERT's method is followed. A. F.

627. **The natural laws of sylviculture.**

MAYR, H. Waldbau auf naturgesetzlicher Grundlage. II. edition. 1 vol. in 8vo p. 568, 27 fig. and 3 tab. P. Parey, Berlin, 1925.

The first edition of this book, published in 1908, aroused great interest and caused keen discussion, as happens to all works which give new impulses to currents of thought. But the foundations of sylviculture established in it by the author were so sound that the editor, on the advice of experts, decided to publish this new edition without changing a word of the original writing.

It is pleasing to note here, as agreeing with the guiding principle of the International Institute of Agriculture, the fact that MAYR correctly pointed out that the fundamental laws of sylviculture are international. And it is precisely for this reason that this treatise, henceforth a standard work, will be read and consulted with profit by anyone, in every country, who is interested in vital questions of sylviculture. A. F.

628. **The effect of grass undergrowth on trees.**

HOWARD, A. (Institute of Plant Industry, Indore). Effect of Grass on Trees. *Proceedings of the Royal Society*. v. 97, p. 284-321, 6 tabl., bibl. London, 1925.

In meadows and pasture lands of temperate regions, trees flourish even when surrounded by numerous grasses which are an artificial product created by man from the original forest and maintained by cutting and manuring. In tropical regions, on the other hand, where pasture lands are scarcer, land covered with grass when protected from animals, quickly becomes covered with shrubs and trees. Although the trees tend to eliminate the grass, in cases of a natural struggle, it sometimes happens that the grasses are capable of suppressing the trees. In various parts of the world, it is noticed that pear trees, apples and cherries do not thrive when there is an undergrowth of grass, if the soil is a heavy clay. The cause of this failure to thrive has been attributed by some people to a soil toxin which however has never been isolated.

Ill effects are lacking or are reduced to a minimum in well aerated and permeable soils, while after all it is certain that under natural conditions the grasses could not hold out against the trees.

The writer has investigated the problem by experiments at Pusa, which is situated on an old alluvium of the Ganges, examining various species of fruit trees. He observed that there were really deleterious effects when the trees were young ; less injury was experienced on the other hand by mature trees. When artificially trenched, some trees, such as

the mango, the loquat (*Eriobotrya japonica*) and the lichi (*Nephelium Litchi*) may recover, while others, such as apple trees, *Citrus medica* and *Anona squamosa* do not feel any effect. The guava (*Psidium Guyava*) can grow fairly well even with an undergrowth of grass and does not feel any effect from aeration. When the causes of these phenomena are investigated, it is observed that the grasses only have an effect on the superficial root system of the tree and not on the deep root system; this effect is shewn in the reduction of the growth of the superficial roots and of the number of active rootlets. Now at all seasons and under all conditions the various root systems show a considerable reaction to improved aeration. Even during the dry season, when the permeability of soil is at a maximum, the deep roots continue to ramify and to form abundant rootlets which grow in the various cavities and in the deep strata. After the rains, the superficial root system becomes markedly aerotropic and enteres into a phase of activity. This is the period of active nitrification and of growth of the leaves and of the trunk. Now the grasses become injurious either by restricting the aeration of the superficial rootlets during the rainy season (monsoon), or by reducing the provision of combined nitrogen during the whole year. There would then be the toxic effect of carbonic acid which accumulates in the soil during the rains, and the decrease of the provision of nutritive material (nitrogen). This explains the good effects which may be obtained in certain cases where trenching is done and those following nitrogenous manuring, which last however is ineffective in the case of the lichi and loquat. The possibility of the injurious effects being due to a hypothetical toxin, may be excluded.

A. F.

CULTIVATION METHODS AND MACHINERY

Irrigation

629. **Use and Waste of Irrigation Water.**

SMITH G. E. P. *University of Arizona, Agricultural Experiment Station Bulletin No.* 101, pp. 17, figs. 10. Tucson, Arizona, 1925.

The Bulletin contains much useful information and concludes with the following suggestions for farmers employing irrigation water:

Keep the ditches in order; line the ditches with concrete or lay cement pipes and so avoid loss by seepage; grade the land surface evenly; plough deeply; use short lengths of land for light soils; divide a large head of water into "unit heads" so as to get uniformity of irrigation; test the soil the day after irrigating to find the depth of water penetration; irrigate before planting; do not over irrigate; do not hesitate to irrigate at night, the evaporation being less at night; irrigate at the most favourable

time, alfalfa when two-thirds grown, maize when in tassel; examine the soil occasionally for texture and moisture; cultivate the soil, a loose surface prevents baking and cracking; eradicate weeds; use a crop rotation containing alfalfa; do not irrigate the roads; measure the water to ascertain how much you receive and how much each crop uses. W. S. G.

63·. **Studies in Soil Cultivation.**

I. KEEN B. A. and HAINES W. B. (Rothamsted Experimental Station). The evolution of a reliable dynamometer technique for soil cultivation experiments. *Journal of Agricultural Science*, Vol. XV, Part 3, pp. 375-386, Plate I, Figs. 3. London, 1925.

II. HAINES W. B. and KEEN B. A. A test of soil uniformity by means of a dynamometer and plough. *Ibidem*, pp. 387-394.

III. HAINES W. B. and KEEN B. A. Measurements on the Rothamsted plots by means of dynamometer and plough. *Ibidem*, pp. 395-409, Plates 2, figs. 6.

An account is given of a reliable technique for making dynamometer measurements in the field, a description and illustration of the dynamometer being supplied. It was shown that small variations in the drawbar pull are significant and correspond to actual variations in the resistance of the soil. No significant change in drawbar pull is produced by imperfect adjustment in the set of the implement within limits met with in ordinary ploughing. The slope of the land is without appreciable effect on drawbar pull up to gradients of 1 in 40.

The drawbar pull increases with speed, but the percentage increase is relatively so slight that saving in labour and other costs should result if the speed of ploughing were increased.

The general conclusion can be drawn from the results that, during a steady run with tractor and plough the variations in drawbar pull can be entirely ascribed to variations in soil texture, or soil resistance.

The unit consisting of tractor-dynamometer-plough should therefore prove useful for making field surveys of soil conditions and characteristics.

II. The site chosen for the experiment was a field known as Sawyer's covering about 6 ¼ acres recently taken into the area of the Rothamsted experimental farm. The field was level and showed no obvious irregularities.

The results have been shown in graphical form, lines indicating regions of equal drawbar pull. The figure has the appearance of an ordinary contour map (figure 1) the "hills" and "valleys" representing regions of high and low drawbar pull, the range of variation being about 40 %.

The results indicate large variations over short distances. The importance is emphasised of assuring and allowing for such variations before drawing conclusions from the drawbar pull recorded by different implements.

III. The authors have drawn maps of soil resistance to ploughing

made during several seasons, on the Rothamsted classical plots, carrying wheat, barley and roots respectively.

The conclusions as to the effect of manurial treatments are only of a general nature at the present stage of the work, but such differences are certainly small in comparison with natural variations in the soil.

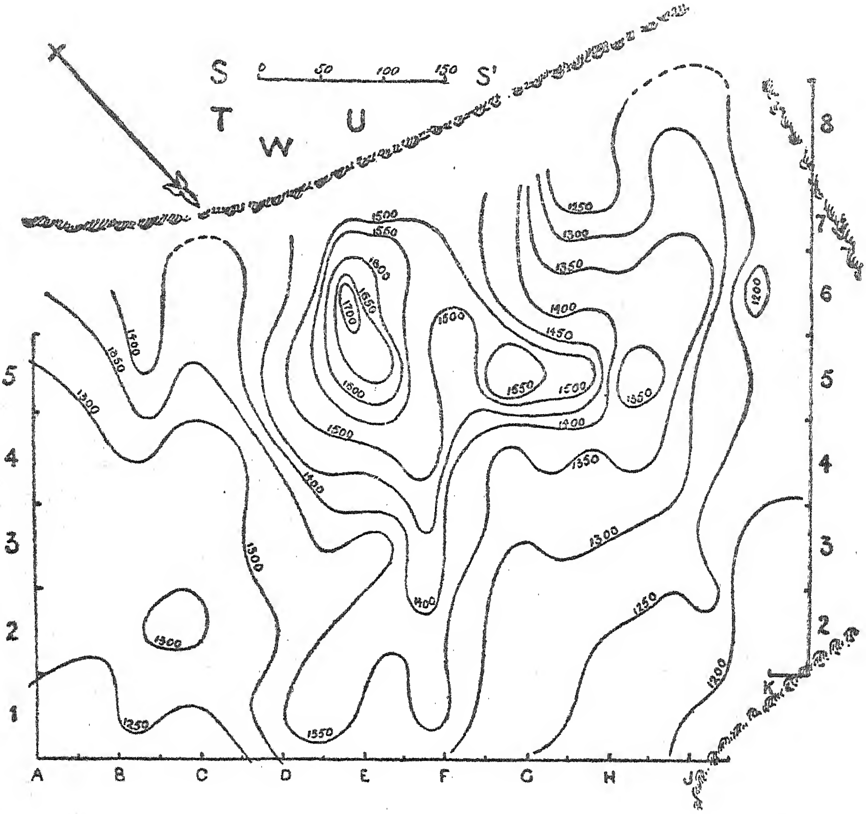

FIG. 136. — Graph of experimental field Showing lines of equal drawbar pull (isodyne contours in lbs.)

S — S′ = scale in feet.

In the case of the Broadbalk wheat plots the drawbar pull values have a close relationship with the clay content of the soil and with certain aspects of the soil drainage. W. S. G.

631. **A Study of Native Ploughs in the Philippines.**

TEODORO A. L. *Philippine Agriculturist*, Vol. XIV, No. 3, pp. 135-142, figs. 3. Los Baños, Laguna, 1925.

The author gives details respecting some typical Filipino ploughs, with illustrations of the complete implements and the various parts.

[631]

It is interesting to note that the share never governs the width of the cut, which is controlled by the mouldboard, whereas in the American plough the share determines the width of the furrow.

An account is given of some preliminary draft tests. W. S. G.

ECONOMICS

632. Cost of Producing Field Crops in 1923.

COOPER M. R. and HAWLEY C. R. *United States Department of Agriculture Circular* No. 340.

The report gives details of an enquiry into costs of production of maize, wheat, oats, potatoes, and cotton during 1923. The study is based on replies to a questionnaire sent to crop and livestock reporters in all the States.

The reports on wheat showed an average gross cost of $22.88 per acre allocated as follows: preparation of seed bed, planting, harvesting and marketing, 45 % of cost; fertilisers 11 %; seed 7 %; land rent 26 %; miscellaneous items 11 %.

The average sales value per bushel was $0.99 and the value per acre was $4.38 less than the cost per acre, hence farmers did not receive sufficient income from the 1923 wheat crop to repay them the cost of production.

This work is to be continued, so that in course of time indices will be available for making comparisons of yearly costs of production of the principal crops. W. S. G.

633. The Legume Problem.

OAKLEY R. A. Economics of Increased Legume Production. *Journal of American Society of Agronomy*, Vol. XVII, No. 7, p. 373. Geneva N. Y., 1925.

BARRON J. H. Utilization of Legumes in Rotation, in the East, *Ibid.*, p. 380.

KENNEY R. In the Middle West, *Ibid.*, p. 389.

OGAARD A. J. In the Northern Great Plains, *Ibid.*, p. 394.

FUNCHESS M. J. In the South. *Ibid.*, p. 398.

BARNES E. E. The Function of Annual Legumes, *Ibid.*, p. 403.

HUGHES H. D. Future of Sweet Clover in the Corn Belt. *Ibid.* p. 409.

FISHER O. S. Relation of Legume Program to other Extension Projects, *Ibid*, p. 418.

CARTER C. E. and SCHOWENGERDT P. F. Campaign, for More Legumes, *Ibid.* p. 431.

The series of articles discusses the importance of leguminous plants in farm economy in its various aspects, special attention being given to

forage plants such as alfalfa, clover, vetch, soybeans, etc. The conditions favourable to each plant, and its particular advantages are described.

The area under leguminous crops in the United States is dealt with by O. S. FISHER, who shows that five States have increased less than 1 %, six have gained up to 10 %, ten from 11 % to 25 %, eight have increased the area from 25 to 50 %, four from 50 to 100 %, and five States show an increase of over 100 %. The reasons, which are many, for this extension of the alfalfa area are discussed by the author.

The further extension of leguminous crops is strongly advocated, and C. E. CARTER and P. F. SCHOWENGERDT outline a scheme which includes advice respecting the growing of different legumes, the main object being the leading and aiding of farmers in the adoption of farm practices that have been proved profitable. W. S. G.

AGRICULTURAL TECHNOLOGY

Utilization of agricultaral produce.

634. **The Power Alcohol Problem.**

HARDY F. *Tropical Agriculture*, Vol. II, No. 9, pp. 192-194. Trinidad, 1925.

The article deals mainly with the various raw materials used, or which might be used, for the production of alcohol, such as sugar, starch, molasses, coal and cellulose substances.

The author considers that sugar and starch are too valuable for the purpose, being foodstuffs ; the supply of molasses would be insufficient, apart from the fact that improved sugar refinery methods are lessening the available quantity of this material. The only suitable raw materials available for large-scale production of power alcohol are coal and cellulose substances.

The cost of production of industrial methyl alcohol from coal has already been reduced to such an extent that it may become a rival of petroleum fuel.

Cellulose substances are available in vast quantities, as waste material from cereal crops, natural vegetation in forests, swamps, etc. This source could theoretically supply alcohol fuel greatly in excess of the present day consumption of petrol. W. S. G.

635. **Preservation of Beets by Desiccation in North Africa.**

MIEGE E. La Conservation des Betteraves par dessication dans l'Afrique du Nord. *Revue Agricole de l'Afrique du Nord*, Year 23, No. 309, pp. 442-444, No. 310, pp. 460-462, No. 311, pp. 479-482. Algiers, 1925.

The cultivation of beets has been tried in Algeria and Tunisia for a number of years, and the results have shown that this crop would give high yields, when well managed. The preservation of fresh beets, how-

ever, which in Europe is a simple matter, is very difficult in a hot climate, as, if left exposed to the air, they putrify rapidly and become useless ; even when placed in a silo they undergo fermentation and the composition is altered and the value diminished.

Storage in the ground presents difficulties and experiments made at Rabat in 1921 showed a fall in saccharose content from August 9 to November 2, from 19.41 % to 7.45 %.

For many reasons, it is desirable to have a process for the preservation of beets which is simple and economical, and desiccation appears to meet these requirements. The method is by no means a novelty and has given excellent results in many countries, but usually requires special installations and the use of combustibles which are often very costly in the Colonies.

Drying in the sun is obviously less costly and more simple and has been tried formerly in California and at Rabat since 1920.

The method followed in Morocco is very simple, the roots being cut into slices which are exposed to the sun, in thin layers. The beets shrivel rapidly, and in three or four days are sufficiently dry to be ensiled or stored in a shed, where they may be kept for several months.

The results of experiments showed that desiccation was practically complete after the third day in the case of thin slices and on the sixth day with hand cut fragments.

The loss in weight of the slices, after the second day was 54 %, and 75 % after the third day. The entire roots take from 8 14 days to dry.

Analysis showed that the moisture content of dried, entire roots fell to 20 % and that of dried slices to 13.15 %, the sugar content increasing from 16-18 % to 55-61, and even to 65.5 %. There is however, a partial transformation of saccharose to reducing sugars.

The sun drying method is of practical value to colonials and even natives, and results in a perfectly preserved product which is appreciated by all farm animals. W. S. G.

636. **Variations in the composition of a sugar beet according to the disintegration of the tissues and the pressure.**

MUNERATI, O. Variations dans la composition du jus d'une betterave suivant l'état de désintégration du tissu et des procédés de pression. *C. R. de l'Académie des Sciences*, vol. 180, No. 15, p. 1176-1178. Paris, 1925.

When a beet is subjected to successive gradually increasing pressures of from 50 to 400 atmospheres, and if the juice corresponding to each pressure is collected, it is observed that the quantity of solid matter in the juice clearly decreases with the increase of pressure.

Different variations are obtained by using different methods of pressure. These facts explain, at least in part, the differences which are sometimes observed between the richness of the pulp in saccharose and that of the juice. In order to make a suitable use of the sensibility of densimeters and to estimate the degree of purity with the maximum precision, it is absolutely necessary to extract the juice from a standardized pulp. A.F.

637. **The composition of the juice of sugar beet in the season of 1924-1925.**

VONDRAK JIRI. (Forschungs-Institut der csl. Zuckerindustrie). Bericht über die Zusammensetzung der Säfte der Kampagne 1924-25. *Zeit. f. die Zuckerindustrie der cechoslovakischen Republik*, Year XLIX, No. 46-47, p. 355-362, 5 tab. Prague, 1925.

It appears from the writer's researches that the purity of the juices of diffusion and of the syrups was much greater and the quantity of nitrogen smaller than in the previous season. Aided by the favourable composition, the manufacture of sugar was facilitated and only in a few factories was there partial deterioration of the beet caused by the very high temperature which was experienced at the beginning of the season, or by difficulty of extraction through diffusion or through a heavy microbic infection by *Leuconostoc*. In some factories the production of magnesian precipitates during the evaporation of the juice was also noticed.

On the whole it was a favourable year compared with the previous four years. A. F.

638. **The action of lactic fermentation on slices of sugar beet.**

KNOR, Fr. *Erfahrungen mit der Impfung ausgelangter* "Schnitzil" mit "Lactazidin" in der Dobrovicer Zuckerfabrik. *Zeit. f. die Zuckerindustrie der Cechoslovakischen Republik*, Year XLIX, No. 17-18, p. 129-132. Prague, 1925.

The treatment of slices of sugar beet with the bacteria of lactic fermentation does not cause any loss of nutritive matter. They are entirely innocuous to cows feeding on them. The objections raised by some investigators to the watering which the slices are subjected to in consequence of the addition of the culture liquid have no force, all the more so as the increase of water barely amounts to 0.26 % of the weight of the slices themselves A. F.

639. **Rational grinding of maize.**

MAROTTA, D. and DI STEFANO, F. (Chemical Lab. of Public Health). *Ann. di chimica applicata*, v. 15, No. 6, p. 227-238. Rome, 1925.

The easy deterioration of maize meal, due to the high percentage of fat contained in the germ, is known and the great advantages which might be gained by degermination before grinding seem evident. Hygienic advantages, because, the portion rich in fatty matter and a ready harbour for germs being eliminated, a better and better keeping meal would be obtained; economic advantages, because the products which are thus derived might be better utilized for feeding cattle.

Degermination is however not possible with the stone grinding mills which are generally used by the country people. In it the maize is crushed and ground between two disks of stone one of which is fixed and the other revolving, so that the germ becomes both reduced to powder and mixed with the meal. Moreover, the increase of temperature through grinding

affects the quality of the product by increased acidity; the product is then also rendered inferior by the high content of cellulose and fatty substances in the grain.

High milling, with cylinders, would remedy these drawbacks, but it is seldom used because the large mills are situated far from the centres of production, so that only 10 million quintals out of the 30 millions consumed in Italy are ground in them. A good remedy for this state of things is afforded by the medium grinding mill with cylinders made on the NEGRI patent, which can work with small quantities just as the grindstones do, performs all grinding operations and has the advantage of giving a completely degerminated product.

In it, the maize, from the magnetic apparatus which serves to keep back the pieces of iron which are generally mixed up with the maize, passes to the first rolling mill with coarse grooved cylinders which accomplish the preliminary fracture. It then passes to those with medium grooving, which completely detach the germs, which along with the first flour are eliminated with the first sifting, and then sacked. It then is passed successively through cylinders with finer grooving varying with local custom, and there occurs the successive classification into fine flour and semolina with elimination of the bran elements. From the writers' analyses the superiority of the meal obtained by this method which, in addition to degermination, makes possible a more rational separation of the bran elements, is evident.

The economic advantage is derived from the collection of the germ which can be used for oil and for making cattle cakes.

The installation costs relatively little and its maintenance is easy and cheap. A. F.

640. **The final crushing of the olive pulp by the same machine.**

GIMENEZ, T. *El progreso agricola y pecuario*, a. XXXI, No. 1394, p. 559-361, 1 fig. Madrid, 1925.

With modern machinery and high pressure it is possible to obtain a 7 % increase from the crushing of the olive pulp, but in order to reach this it is necessary to increase the thickness of the net containers so that the larger output does not balance the greater expense of the containers.

Considering that the greatest drawback to the extraction of the oil from the olive is the stone, the previous separation of it solves the problem of the final crushing of the pulp.

With the "Tafur" machine of Spanish construction it is possible to obtain this separation soon after the first crushing of the cold mass of olives. The advantages thus obtained are: decrease in the breakage of the nets as it is not necessary to employ very high pressure in the first crushing of the pulp; first pressing of the pulp up to 4.80 % with hardly any expense in view of the fact that the lever or the beam of the hydraulic press can be used; the oil so obtained is perfectly edible and the colour, odour and taste exactly the same. Fresh pulp must, however, be used.

Continuing the author cites a series of testimonials on the "Tafur"

machine, amongst which is one given by various experts present at the experiments carried out at Villafranca de los Barros (Prov. Badajoz).

Of great importance is the use that can be made of the residue. As no stones remain in the pulp it does not present the drawbacks that up till now have been experienced when using it for feeding live stock. The "*Estación Agronómica Central*" of Madrid states: "This pulp is an excellent food for pigs and in fact for live stock in general, but care must be taken to mix it with other fodder when giving it to other animals".

The author according to a calculation based on practical results, calculates a certain profit of 102 pesetas for each 1000 kg. of pulp so treated when using the "Tafur" machine which works at the rate of 500 kg. of pulp and stone per hour with a motor of 2 HP. E. M. F.

641. **The toxicity of cotton seed oil and cottonseed.**

SCHWARTZE, E. W. and ALSBERG, C. L. (Bureau of Chemistry, U. S. Department of Agriculture). Relation between Toxicity of Cottonseed and its Gossypol Content. *Journ. of Agricultural Research*, vol. XXVIII, No. 2, p. 173-189, 13 fig., bibl. Washington, S. C., 1924.

Id. Pharmacology of Gossypol. *Ibidem*, p. 191-197, 2 tab., bibl.

The toxicity of cotton seeds is due to their oil content; the different toxicity of seeds coming from various localities is thus explained, inasmuch as the quantities of oil contained in them are different. Confirmation of this assertion is given by the fact that in the States on the Atlantic coast, where the seeds contain about 1 % of oil, their toxic effect is more feared than in the South-West States in which the oil is found in smaller quantities in the seed.

When cottonseed oil is administered to animals in small quantities, so as to avoid any considerable loss of appetite but to cause chronic poisoning, it is seen that paralysis, degeneration of the nerves, dyspnoea, cardiac hypertrophy, oedema of the anogenital region and of the lungs, discharges in the serous cavities occur. With injection, pulmonary oedema and discharges in the cavities, lowering of blood pressure and death by cardiac insufficiency are caused.

Cotton seed oil can therefore produce all the symptoms which are observed in animals poisoned by the seed (diarrhoea, loss of appetite and weight, dyspnoea and paralysis). Such poisonings are therefore attributable to the oil. A. F.

642. **The Seeds of *Citrullus Vulgaris* as a Source of Oil.**

Bulletin of the Imperial Institute, Vol. XXIII, No. 2, pp. 149-157. London, 1925.

The water-melon (*Citrullus vulgaris*, Schrad.) is now cultivated throughout all warm countries. Seeds of different varieties have been examined at the Imperial Institute as a source of oil.

Four samples of seed from the Gold Coast, called "Neele" or "Niri" seed yielded a yellow oil, the percentage in the seeds as received varying from 33.8 to 44.4. The oil would be classed as a "semi-drying" oil; the residual meal is richer in crude protein (28.2 % to 35.3 %) than undecorticated cotton-seed cake; no cyanogenetic glucosides were found, but there were indications of an alkaloid substance. The seed was valued at £17 to £18 per ton.

Seed received from Sierra Leone gave an oil somewhat greener in colour than that from the Gold Coast, but very similar in character.

Samples of *Citrullus vulgaris* seed from the Kano province of Nigeria were forwarded in September, 1924. The plant, known locally as "Guna", is grown as a catch-crop on millet farms. The seeds are used both for food and oil extraction. Guna oil is not so sweet as groundnut oil, but is much cheaper.

The seeds contained 6.4 % moisture and 45 % oil. The oil was a pale greenish-yellow liquid, with a slight, pleasant odour. Guna oil, like other varieties of *Citrullus vulgaris*, is a "semi-drying oil" and the constants closely resemble those of cotton-seed oil. The residual meal, after extraction of oil with light petroleum, was odourless and almost tasteless; meal with 7 % fat contained 40 % crude proteins, and was free from alkaloids and cyanogenetic glucosides.

Guna seeds as a source of oi lwould be worth in London about £17 to £18 per ton in consignments of 100 to 200 tons. Guna oil of good quality should realize the current price of crude Egyptian cotton-seed oil (about £47 per ton, January 1925). The residual meal would probably realize in Great Britain rather less than extracted soy bean meal, quoted about £12 per ton. W. S. G.

643. **Bacterial Deterioration of Cotton During Damp Storage.**

BURNS A. C. (Cotton Research Board, Cairo). *Jnl. of Textile Institute*, Vol. XVI, No. 6, pp. 185-196, figs. II, bibliography. Manchester, 1925.

The author's investigations showed that :—

1) Bacterial and fungoid infection, as a source of deterioration of cotton during damp storage, is to be sought for and controlled in the unginned rather than in ginned cotton.

2) Cotton which has been exposed to very damp storage before ginning is much less resistant to bacterial or fungoid attack during subequent storage than is cotton stored under dry conditions.

3) Ventilation of cotton during storage "in seed" represses bacterial and fungoid processes only in cases where the damp material is able to dry rapidly.

4) Sun drying of cotton is advocated in addition to ventilation, particularly before storage "in seed" and prior to baling after ginning. The process of damping cotton before or during baling is not recommended.

W. S. G.

644. **The Modern Treatment of Flax.**

EYRE J. VARGAS (Director, Linen Industry Research Association). *Jnl. of Textile Institute*, Vol. XVI, No. 8, pp. 250-256. Manchester, 1925.

The special value of the flax fibre lies in the fact that it can be separated in the form of long, fine, strong, strands or groups of fibres, which are much finer than those of hemp or jute ; in comparison with ramie, the individual fibres composing the strands are shorter and finer, and in comparison with cotton, although but very little longer, lack the convolutions, which make the spinning of cotton comparatively easy.

The maximum length of the strand is theoretically determined by the length of the branchless part of the flax stem, but in practice depends largely on the care taken in harvesting and retting, and other operations.

After harvesting, the next important process is that of retting, a bacterial fermentation of pectinous substances which surround the fibre in the plant. The process may be carried out, with or without access of atmospheric oxygen, the former by dew retting, the latter by water retting.

Many modifications of the water retting process have been made, by raising the temperature of the water, the addition of cultures of organisms, etc., but with only partial successs. The addition of chemicals to the water in which the flax is steeped has been tried, but the resulting fibre has not proved satisfactory to the spinner.

The various methods of retting involve retting the straw and subsequently drying for the next operation ; many attempts have been made to dry retted flax straw by artificial means, but no efficient method has yet been evolved.

Between every stage in the working of flax advantage accrues from giving the fibre a rest.

If uniform crops could be harvested, retting would be more uniform but the wide variations and irregularities in the harvested crop has made machine scutching unsuccessful up to the present, and hand scutched fibre is superior.

The future of the linen trade seems to depend largely upon the production of better quality goods from lower grade materials, a state of affairs which calls for a fuller knowledge of the properties of the raw materials.

W. S. G.

645. **The Value for Paper Making of " Bakaka ".**

DE BALZAC F. H., MAHEU J. and CERCELET, M. *Bulletin de l'Agence Générale des Colonies*, Year 18, No. 204, pp. 360-372, plates 2. Paris, 1925.

Samples of the stems of the " Bakaka " plant, a species of sorghum (*Sorghum vulgare* Pers.), were received from Madagascar for investigation as to suitability for paper making.

The authors give details respecting the botanical and chemical constitution of the plant, and also of the preparation of paper from the material.

The investigation showed that the stem of the bakaka plant is rich in cellulose, and after treatment yields 37 %, which compares favourably with the cellulose yield of many other plants. The content of woody matter and ash is low, and both are easily eliminated.

The material is easily bleached, gives a good yield and furnishes a paper of good quality. W. S. G.

646. **Preservation of Perishable Fruits and Vegetables.**

OVERHOLSER Prof. E. L. (University of California). *Refrigerating World*, Vol. 60, No. 7, pp. 25-26. New York, 1925.

It is well-known that fruits such as figs, apricots and peaches cannot be kept long in the fresh condition at cold storage temperatures of 32° F. to 35° F.

The author carried out investigations from which the following conclusions were drawn: —

Strawberries, raspberries, loganberries, blackberries, cherries, figs, apricots, peaches, currants and gooseberries, frozen at 10°-12° F., in water or sugar solution, or crushed with or without sugar, in closed containers, were kept for a year without deterioration of colour or flavour.

Freezing with dry sugar, kept quickly perishable fruits for use in pastries, ice cream, jams etc.

Fruits frozen in 30-40 % sugar solution were as excellent as fresh fruit.

Shelled fresh peas and asparagus have been frozen in water and subsequently cooked and have retained the flavour of the fresh material.

W. S. G.

647. **The causes which determine the cooking capacity of vegetables.**

D'IPPOLITO, G. (R. Agricultural Station of Modena). *Le Stazioni sperimentali agrarie italiane*, vol. LVIII, parts. 1-6, p. 128-145, bibl. Modena, 1925.

The phenomenon of the cooking capacity of vegetables has been attributed solely to the degree of hardness of the water. On the other hand, it is well known that vegetables which are easily cooked are grown on certain soils rather than on others and it is considered by some people that calcareous soils produce hard vegetables, an assertion which is disproved by the facts, inasmuch as the coastal regions of the Lower Adriatic with particularly calcareous soil produce very good kinds of vegetables, noted for easy cooking.

Now it is a fact that all varieties of vegetables are cooked more or less satisfactorily in distilled water. There are however vegetables capable of being well cooked in hard water and it is only to these that the qualification *easily cooked* will be applied.

This quality is in relation to the histological constitution of the amyliferous tissues. When in the membrane the pectic compounds prevail and are in a soluble state, or in a condition to be hydrolized, the tissue

then is easily decomposed, acquiring a special softness by reason of which the vegetables can be cooked in all waters.

When, on the other hand, cellulose, and hemicellulose and the pectic compounds are not in a condition to be hydrolized, the amyliferous tissue then preserves its original rigidity increased by the smaller dimensions of the elements, and the vegetables do not cook well.

The action of bicarbonate of soda, used in the kitchen for cooking vegetables, might be explained by admitting that, by its solvent action on pectoses, it causes the breaking down of the amyliferous tissue and consequently the pulpy condition of the mass. But since it does not modify the rigidity of the cell walls, it only produces a partial cooking very different from natural cooking.

In old vegetables, we get equal power of absorbing water and swelling of the starch, but the membrane of the amyliferous cells is no longer in a condition to undergo those changes of which it was capable when young; hence the resistance of old vegetables to cooking. During cooking the amyliferous cells remain intact. A. F.

648. Cold Storage of Oranges.

HARRISON J. E. *Journal of Department of Agriculture of Victoria*, Vol. XXIII, Part 7, pp. 428-432, tables 7. Melbourne, 1925.

Experiments on the cool storage of Washington Navel oranges were carried out to ascertain the conditions which retard or develop the growth or mould in storage.

The value of sweating was studied; the process being carried out at a temperature of 70° F., until the skin of the fruit was soft and pliable. Wrapping the finit in paper had little influence on mould development.

As a result of the experiments it was found that :—

(*a*) The process of sweating offers the best means of guarding against the outbreak of mould in cool storage.

(*b*) An average temperature of 32°F, is unsuitable, owing to the danger of freezing.

(*c*) The average temperature of 34°F. will avoid the danger of freezing and gives less mould than higher temperatures, and is recommended.

(*d*) The fruit from different districts varies in keeping quality.

W. S. G.

649. Quantitative determination of lactic acid.

LEONE, P. and TAFURI, G. B. (Istituto chimico della R. Università di Roma). Sulla determinazione dell'acetaldeide nella determinazione quantitativa dell'acido lattico. *Annali di chimica applicata*, v. 15, No. 5, p. 206-208. Rome, 1925.

To avoid the drawbacks experienced with various methods of determination of lactic acid, especially in muscles and in cheeses, the writers suggest the following method, based on the determination of acetaldehyde.

The solution containing lactic acid is placed in a KJELDAHL apparatus with 50-100 ccs. of H_2SO_4 at a 50 % strength and is distilled for an

hour keeping the temperature between 140°-150° and collecting the distillate in a solution of hydroxylamine of standard strength (N/10 or N/100 according to the degree of precision required and the quantity of lactic acid present) in which hydroxylamine has been set free, with previous addition of NaOH solution strong enough to render the solution exactly neutral using Phenolphthalein as indicator.

During the operation a slight current of air is made to pass into the apparatus which removes the aldehyde as it is formed. An oxime is thus obtained. The excess of hydroxylamine is then measured with a solution of H_2SO_4 of strength corresponding to that of the previous solutions, using methyl-orange as indicator. The difference between the hydroxylamine introduced and determined by a decoloration test and that given, represents the hydroxylamine combined with the aldehyde and hence corresponding to the lactic acid. The process is based on the fact that phenolphthalein is not sensitive to hydroxylamine, while methyl-orange is very sensitive to it. The decoloration test of the hydrochlorate solution of hydroxylamine is effected by exactly neutralizing 25 cubic cm. with the standard solution of NaOH, using phenolphthalein as indicator, and afterwards adding a few drops of methyl-orange; the hydroxylamine which has been set free by the NaOH is measured with H_2SO_4.

A. F.

PLANT PROTECTION

Plant Parasites.

650. **Plant Diseases and Pests in the Argentine Republic during 1918-1923.**

GIROLA, C. D. and ARAÚJO, J. J. Enfermedades de las Plantas. Lista de las observadas en la República Argentina en los años de 1918 a 1923. Publicación del Museo agrícola S. R. A., No. 46, pp. 46. Buenos Aires, Imprenta "Gadola", 1925.

Enumeration of plant diseases and pests observed by the authors in the Argentine Republic from 1918 to 1923.

Seven bacteria and sixty-seven fungi appear in the list as agents of disease; there are also included one parasitic Phanerogam and forty-one Nematodes, spiders, and especially insects.

The diagnostic characters of the diseases caused by bacteria and fungi are summarised; the common local names of these and of the parasitic animals are mentioned together with indications of the respective means of control.

There follows an alphabetical list of the sixty-one plants attacked, the scientific and common names of which are given.

G. T.

651. ***Phyllosticta Pollaccii* n. sp., Deuteromycete parasitic on *Acacia Baileyana*, in Italy.**

AGOSTINI. Una nuova malattia dell'Acacia Baileyana F. Muell. (Phyllosticta Pollaccii n. sp.) *Rivista di Patologia vegetale,* Year XV, No. 5-6, p. 113-122, 4 fig. Pavia 1925.

During May 1925, on some specimens of *Acacia Baileyana* growing in the Botanical Garden of Siena, which had been grafted in 1923 on *A. floribunda,* it was noticed that the leaflets, specially those belonging to adult leaves, were spotted in a characteristic manner on both sides. The spots were formed of three successive differently coloured zones, from about the centre of the limb towards their apex : next to a first yellowish zone came a brown zone succeeded by an ash-grey zone. On this last, occupying the apical portion of the leaflet, there developed, like little black sparse points, the epiphyllous picnidia of a sphaeroidea regarded by the author as the cause of the injury and described as a species new to science under the name of *Phyllosticta Pollaccii.*

The attacked leaflets finally fall to the ground, when it is desirable to remove and destroy them. Sprayings with Bordeaux mixture, before the flowering season will serve to prevent the attack of the Deuteromycete.

The description of the new *Phyllosticta* is preceded by some notes regarding the importance of the growth of various species of *Acacia* and by a list including one Myxomycete and eighty-two Fungi already observd on this same plant. G. T.

652. ***Cudoniopsis pusilla* n. gen. and n. sp., Ascomycete parasitic on the *Myrtacacea Eugenia proba*, in Argentina.**

SPEGAZZINI, C. Un nuevo género de las Helvellaceas. *Mycologia,* vol. XVII No. 5, pp. 210-212, 7 fig. Lancaster Pa., 1925.

Description of a Discomycete of the fam. *Helvellaceae* which the writer considers as representing a genus (*Cudoniopsis*) and a species (*Cud. pusilla*) new to science.

The fungus in question was observed behaving as a parasite on live branches, two or three years old, of the *Myrtacacea Eugenia proba* Berg. in Argentina, and, to be exact, in the neighbourhood of Puerto Blest (Neuquen). C. T.

Insect Pests.

653. ***Binema-binema* n. gen. et n. sp., and *B. arnata* n. sp., Nematodes parasitic on the Arthopteron *Grillo-talpa* (Neocurtilla) *hexadactyla* in Brazil.**

TRAVASSOS, L. Quelques Nématodes du *Gryllotalpa. Comptes rendus des séances de la Société de Biologie et de ses filiales,* Vol. XCIII, No. 21, pp. 140-141, 7 fig. Paris, 1925.

In the province of Angra dos Reis (State of Rio de Janeiro), the author found three Nematodes parasitic on *Gryllotalpa* (*Neocurtilla*) *hexadactyla*

Pty. of which he describes the first two, observed in the posterior intestine of the Orthopteron ; the author has instituted the new genus *Binema* for them, naming the type species *B. binema* and the other *B. ornata*.

Both these species have the peculiarity of laying two eggs, rarely three, enclosed in capsules similar to those of some Cestodes. G. T.

654. **Hymenoptera Parasites of *Coelaenomenodera elaeidis Coleoptera*, injurious to the Oil Palm on the Gold Coast.**

WATERSTON J. On some Eulophid Parasites (*Hym. Chalcidoides*) of the Oil Palm Hispid Beetle. *Bulletin of Entomological Research*, Vol XV, part 4 385-395, figs. 6. London, 1925.

The oil palm (*Elaeis guineensis*) is periodically subjected, in West Africa, to the attacks of *Coelaenomenodera elaeidis* Maul., a Coleopteron of the *Hispidae* fam., which bores galleries in the leaves of its host.

G. S. COTTERELL, Assistant Entomologist on the Gold Coast, has obtained by breeding, from the first stages of development of *C. elaedis*, collected at Aburi in 1923, some Hymenoptera (*Eulophidae* fam.), parasites of such Coleoptera, new to science, of which the author now gives the detailed description :

(1) *Dimmockia aburiana* n. sp. bred from *C. elaeidis* ;

(2) *Cotterellia podagrica* n. gen. and n. sp. The females of *C. podagrica* issued from the pupa of the Coleopteron and once from its larva, while the males were always obtained from *C. elaeidis* larvae ;

(3) *Closterocerus africanus* n. sp., obtained by breeding from *C. elaeidis* eggs ;

(4) *Achrysocharis leptoerus* n. sp., bred, like the preceding, from *C. elaeidis* eggs. G. T.

655. **Coleopterae predatory on *Parlatorea blanchardi*, a Coccid injurious to the Date Palm in Algeria.**

BALACHOWSKY, A. Note sur deux prédateurs du *Parlatorea blanchardi* Targ. et sur leur utilisation en vue de la lutte contre ce Coccide. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord.* Vol. XVI, No. 6, pp. 167-172, tab., 1 map. Algiers, 1925.

Parlatorea blanchardi (Targ) Leon, known for a long time in the South of Algeria, appeared suddenly during 1920 in the Colomb-Béchar palm groves where it multiplied so rapidly that shortly after not only was the date crop much reduced, but the palms themselves were threatened with death. On the other hand in Oued Rhir and Mzab, where probably the Coccid has always existed, its damage was insignificant This has led to the supposition that in these latter localities there existed natural enemies of the parasite. The author visited in March and May 1925, the district of Biskra-Touggourt, and discovered south of Constantine two Coleopterae, *Cybocephalus seminulum* Bandi (fam. Nitidulidi) and *Pharoseyammus anchorago* Fairm (fam. Coccinellidae), active predatory beetles — the former

in the adult and larval state, the latter only in the larval state — of *Parl. blanchardi.* Together with the two Coleopterae mentioned lives also *Cyb. flavipes* Reitt. *Pharosoyamus anchorago* has also been found in the south of Tunisia.

Cyb. seminulum exists in Oued Rhir, Mzab, Ouargla and El Goléa.

The distribution of *Parl. blanchardi* in the south territory may be subdivided into three zones :—

(1) Zone of old invasion, where the coccid has always existed and where its damage is restrained by predatory agents :— district of Oued Rhir, Djerid, the oases of Mzab, Ouargla and El Goléa.

(2) Zone of recent invasion, where the Coccid has been introduced without its predatory agents and the damage which it causes there is considerable :— Colomb-Béchar, Touat-Inzegair, Gourara (Adjedir-Chergui and Fatia).

(3) Neutral zone, where the Coccid has not yet appeared, comprising principally the oases of Tidikelt (In Salah) and all the Moroccan palm groves.

Individuals of the predatory beetles mentioned, despatched on the 20th May by rail from El Arfiane to Colomb-Déchar, for acclimatisation, arrived dead after five days, since the predatory beetles themselves, even when provided with abundant food, do not survive more than two days of activity.

The only way of getting over this obstacle would be to obtain the insects as near as possible to the place where they are to be disseminated and not to keep them captive for longer than twenty four hours as a maximum ; this might be done if the predatory insects were taken at El Goléa and sent by aeroplane to Colomb-Béchar. G. T.

656. Hymenopterae parasitic on the "Grape Moth" (*Polychrosis botrana*), in Algeria.

DELASSUS. Contribution à l'étude de l'Eudemis en Algérie. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord,* Vol. XVI, No. 6, p. 166. Algiers, 1925.

For two or three years the damage caused by the "grape moth" (*Polychrosis botrana*) in Algeria has increased in intensity. Such damage was considerable during 1924 in the Mitidja plain and in Algerian Sahel, more especially in the districts of Rouiba, Maison-Blanche, Maison-Carrée, Boufarik, Douéra, Draria, etc.

Insecticide sprays have not up to the present given decisive results.

In March 1925, the author found in large numbers, especially at Maison-Carrée and Maison-Blanche, three Hymenopterae which he considers may effectively help the vine growers in controlling the Microlepidoptera. These parasites of *Pol. botrana* are the Calcidids *Dibrachya boucheamus* Ratz. and *D. affinis* Masi, and the Ichneumon *Hemiteles areator* Grav.

The first two appear to be much more common than the last.

G. T.

657. **Varieties of sweet potato resistant to root Nematodes *(Heterodora radicicola)*, in California.**

WEIMER, J. L. and HARTER, L. L. Varietal Resistance of Sweet Potatoes to Nematodes, *Heterodora radicicola* (Greaf.) Müller, in California. *Phytopathology*, v. 15, No. 7, pp. 423-426. Lancaster, Pa., 1925.

Observations made during the spring of 1923 show that *Heterodora radicicola* was fairly common in the district of Los Angeles and other places in California where the Nematode — easily propagated by tubers of infected seed — had caused previously and still causes more or less serious damage to the sweet potato crop.

The discovery made in one of the fields examined that *H. radicicola* attacked certain varieties of sweet potato much more seriously than others, led to the consideration of the possibility of controlling the Nematode by means of the use of resistant varieties.

Cultivation tests were therefore carried out, in 1924, at Garden Grove, Baldwin Park and Santa Ana making use of eight varieties (" Red Brazil ", " Red Jersey ", " Southern Queen ", " Big stem Jersey ", " Yellow Belmont ", " Nancy Hall ", " Porto Rico " and " Little stem Jersey ") the tubers of which, previously disinfected with corrosive sublimate at a strength of 1 % for 10 minutes, were then planted in ground known to be strongly infected by *H. radicicola*.

It was thus ascertained that the varieties " Red Jersey ", Little Stem Jersey ", " Big Stem Jersey ", " Porto Rico ", " Southern Queen " and " Yellow Belmont ", if not entirely immune, are highly resistant and may take the place of more susceptible varieties on land infested by the nematode. The more resistant varieties of sweet potato can also be used instead of other more susceptible crops on sandy soil infested with *H. radicicola*.

G. T.

658. **Diptera belonging to the genus *Atherigona* injurious to various plants, in India.**

MALLOCH, J. R. Some Indian Species of the Dipterous Genus *Atherigona* Rondani. *Memoirs of the Department of Agriculture in India*, Entomological Series, vol. VIII, No. 11, pp. 111-125, 3 Tab. Calcutta, 1925.

Until recent times the species of the genus *Atherigona* Rondani were considered innocuous, since the larvae of these Diptera, which were known, only fed on decomposing vegetable matter.

Researches of entomologists of the Department of Agriculture at Coimbatore having, however, shown that many larvae of Atherigona, existing in India, are injurious to cereals and other plants, the writer with the object of facilitating inquiries regarding these insects undertook the identification of the adults, which are very similar to each other. Some of the descriptions in the present paper were previously published elsewhere: they have been reproduced here for the convenience of students. As an appendix is reproduced a short note by Y. RAMACHANDRA RAO, who deals with the habits, the geographical distribution (in India) and the plants

on which the Indian species of *Atherigona* described by MALLOCH feed.

Among these species may specially be mentioned :—

1) *Ather. destructor* reared from *Panicum miliaceum*, *P. miliare*, *P. frumentaceum* and *Setaria italica* ;

2) *Ather. nudiseta*. reared from *P. stagninum*, *P. frumentaceum* and *P. colonum* ;

3) *Ather. indica*, reared from *Andropogon Sorghum* ;

4) *Ather. pallidipes*, reared from a cocoon of *Oryctes* ;

5) *Ather. pallidipalpis*, reared from seed potatoes. ;

6) *Ather. atripalpis* n. sp. reared from *Setaria italica* var. "Sadaitenai" and from *Panicum plicatum* ;

7) *Ather. oryzae* n. sp., reared from rice, from wheat and from *Rottboellia compressa* ;

8) *Ather. eriochloae* n. sp., reared from *Eriochloa polystachya* ;

9) *Ather. miliaceae* n. sp., reared from *Panicum miliaceum* ;

10) *Ather. approximata* n. sp., reared from *Pennisetum typhoideum* ;

11) *Ather. bituberculata* n. sp., reared from *Paspalum scrobiculatum*.

G. T.

659. *Scutigerella immaculata*, Myriopod injurious to Crops in France.

FEYTAUD, J. Sur les ravages causés par un Symphyle (*Scutigerella immaculata* Newport). *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. XI, No. 26, pp. 725-726. Paris, 1925.

The swarming and harmfulness of *Scutigerella immaculata* Newp. in crops in France is mentioned, apparently for the first time. The author noticed that in the southern portion of the Landes, during 1925, this myriopod causes injury particularly to the root system of maize, the cultivation of which in certain places is made impossible. Farmers of this area for some years past attribute the damage noted in their crops of maize, beans, beet, etc. to the presence of some root-eating Aphids and *Scut. immaculata*, previously recognised as injurious in the island of Guernsey and in the United States of America. G. T.

660. *Ortheziopa reyinei* n. g. and n. sp. and *Rhizoecus coffeae*, n. sp., a Coccid Injurious to Coffee, in Dutch Guiana.

LAING F. Description of two species of Coccidae feeding on roots of Coffee *Bulletin of Entomological Research*, Vol. XV, part. 4, pp. 383-384, 2 figs. London, 1925.

In Dutch Guiana two coccidae which live on coffee roots have been collected.

The author has recognised the first as being a representative of a genus and a species new to science, which he here describes respectively under the names of *Ortheziopa* and *O. reynei*.

The second coccid, found at Paramaribo, is styled by the author *Rhizoecus coffeae* n. sp. G. T.

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